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ENGINEERING AND EQUIPMENT

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12 March 1980

USSR REPORT

ENGINEERING AND EQUIPMENT

No. 65

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NEW EARTH-CUTTING TECHNIQUE

SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Sep 79 p 4

[Article by V. Klyachko, Saratov]

[Text] It was a Siberian frost. But people gathered in the yard of Saratov Polytechnica Institute did not seem to notice it at all. Because right in front of their eyes there was a miracle occurring.

A strange device was attached to the back of a Belarus' tractor. It wasn't a drill or a corkscrew. It was a drive and a steel point driven into the frozen ground. Literally within an instant clods of earth around the "corkscrew" began to heave and it rose from a neat round hole. How was it possible to "uncork" the ground so quickly and easily?

"In the centuries of earth-moving technology the basic principle has almost not changed," said D. Lozovoy, head of the department of construction and road machinery. Both the spade, known since time immemorial, and the latest walking and rotary excavators all mellow the soil, mainly by compressing it. Any material can resist compression loads better than cracking. Is it impossible to "rip" the soil in earth-moving work? It turns out that you can. This is the underlying principle of the new machinery.

Imagine that a long corkscrew is screwed into a sealed bottle. When its end touches bottom, you continue turning. You will find that the cork slips up along the corkscrew and finally jumps out of the neck.

The actuator of our frozen soil loosener is a screw with sharp ends. It goes into the ground easily. But that's not important. The screw must encounter resistance at a specific depth and jerk the earthen "cork" out. The special shape helps do this. Many calculations and tests had to be done until the optimum shape of the cutter was found.

It is remarkable that with a diameter of only 250 millimeters the screw is able to develop 80 tons of traction. This makes it possible to enter the frozen ground without any percussion and use special wedges to break up and pulverize the soil clumps.

Frozen ground is not only rock hard but it acts like emery--the strongest steels of excavating cutters quickly wear out in it. The drill designed in Saratov, however, undergoes almost no wear.

The fact is that when rapidly screwing into frozen ground, ice lying near the drill surface melts. This forms a watery lubricant. It's just like what happens beneath ice skates. This protects the working surface from wear.

The designers created an original manual instrument which operates on the same principle. This version of a frozen ground ripper weighs only about 20 kilograms and has a motor of roughly the same output as a home vacuum cleaner. But it screws into the ground and rips it with the force of several tons!

What then does the use of the new cutters promise?

"In construction alone, we have to work over a billion cubic meters of frozen ground each year," continues D. Lozovoy. "But the ever increasing amount of construction in Western Siberia and other northern regions of the country dictates the need to work year-round. And we can't get around this inexpensively: manual excavation of frozen ground costs about four rubles per cubic meter, and sometimes even more. Calculations show that our frozen soil ripper can do the same work for 17 or 18 kopeks!"

The introduction of the frozen soil ripper does not require any special machinery. It is tractor-mounted, is easily assembled, on a tractor for example, or instead of a bucket on a serial excavator. If you consider that almost half the territory of our country is permafrost, that in most regions the soil is frozen 1 or 2 meters deep in the winter, it is completely understandable what advantages are promised by the introduction of this new device.

[14-8617]

8617

CSO:1861

BRIEFS

POLLUTION CONTROL--Scientists of Kazakh Scientific-Research Institute of Hydrometeorology developed original plans for conserving the purity of urban air. The capital of Kazakhstan, Alma-Ata, is surrounded by a giant wall of mountains. The city lies in sort of a giant crater. Thus it is not very windy here. For days on end neither the leaves nor the trees stir. The lack of a natural "fan", of course, does not help to clean the air supply. Here is what the scientists have come up with. Imagine tremendous black balloons floating over the center of town. The altimeter reads 200-300 meters. These balloons have been given an unusual role: to "cleanse" urban air of harmful impurities and gases. This is how these unique "air conditioners" work. The black envelopes of the balloons are quickly heated by the sun. The red hot surfaces start to "pull" the air upward in vertical flows. On top, powerful horizontal air flows "grab" the dirty air and carry it off. Based on mathematical calculations, scientists have found an outflow-inflow balance of air in Alma-Ata. The polluted air blown beyond the city limits will be counterbalanced by natural breezes. The results of research by scientists have now been handed over to the Kazgiprograd Institute for practical utilization. [Text] [Alma-Ata SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Aug 79 p 4] 8617 [417]

CSO: 1861

BRIEFS

THE STRICT VERTICAL--This concept greatly defines the quality of construction of tall industrial stacks and TV and radio towers. It is difficult to maintain a strict vertical position. Pipelayers from Spetszhelezobetonstroy used a zenith sighting device for this purpose, but absolute precision still could not be achieved. Scientists of the Novocherkassk Polytechnic Institute designed an original laser device. The system is based on the interaction of the laser beam and photoelectric cells placed at a specific height on the structure being erected. As soon as the tracking device locks on a deviation, a signal is transmitted to the control circuit. The laser has already been used in laying the 220 meter long pipe of the Volgograd TETs-3 and the Tallin TV tower. A 150 millimeter deviation is permissible, but pipelayers of Spetszhelezobetonstroy reduced to by almost 9/10 thanks to "beam monitoring". [Text] [Novocherkassk NEDELYA in Russian No 39, 24-30 Sep 79 p 1] 8617 [417]

CSO: 1861

NEW MAGNETOHYDRODYNAMIC ENERGY UNIT

Moscow PRAVDA in Russian 1 Oct 79 p 1

[Article by R. Kuznetsova]

[Text] The first 500 megawatt industrial magnetohydrodynamic power plant is being constructed in Ryazan'. The electric power plant should produce current in 1985. Elaboration of designs for the plant is being carried out by the Energiya Scientific-industrial Association of the Ministry of Energy and Electrification of the USSR. The unit will consist of a 250 megawatt MHD generator and standard steam turbine. P. S. Neporozhniy, minister of energy and electrification of the USSR, tells us about the first-born of a new trend in energy.

"Petr Stepanovich, what is the distinctive feature of the new plant?"

"The magnetohydrodynamic method is one of the most promising means of direct conversion of thermal energy into electricity. It permits us to significantly increase the economic efficiency of thermal electric power plants. It is assumed that first-generation MHD electric power plants will be about 50 percent efficient, and second generation--up to 60 percent versus 40 percent in the best thermal power plants.

In the first stage already, the relative consumption of fuel is down 20-30 percent. According to calculations of experts, the unit of the industrial plant in Ryazan' under construction will bring about 20 percent fuel savings as compared to energy units operating in the classical thermal circuit. It also needs half the water.

"Another advantage: in MHD plants it is theoretically possible to achieve output on the order of 1,000 megawatts in one unit. In other words, it is able to produce as much energy as two pre-war Dneproges plants could produce."

"What scientific ideas were used in designing the new unit?"

"In any conductor moving across a magnetic field, electrical potentials arise and if they contact an external circuit, electrical current will flow in it."

"The role of the conductor in a magnetohydrodynamic generator is played by the plasma--an ionized conductive gas. Organic fuel is ignited in a special combustion chamber. At a temperature of about 3,000 degrees, the combustion products become a plasma. This is facilitated by so-called "additives"--potassium or cesium salts. In the special MHD channel, the plasma enters into interaction with the intense transverse magnetic field. The nascent electrical current is tapped off by electrodes from the channel, converted to A.C. and then directed into the energy system.

"At the output of the MHD generator the plasma temperature remains rather high--about 2,000 degrees. This hot jet will be directed into the steam generator of an ordinary thermal electric power plant. Hence there is additional gain.

"The creation of the industrial power plant was preceded by intensive research work, especially on the current U-02 and U-25 Soviet devices created at the Institute of High Temperatures of the USSR Academy of Sciences. They made it possible for specialists to solve many scientific and technical problems. Research work on prototype industrial U-25 facilities, which has operated for more than 10,000 hours, is continuing."

"How do MHD electric power plants relate to environmental protection?"

"Remember that from one hundred grams of coal, fuel oil and gas burned in the furnaces of thermal power plants, only 40 grams go toward producing electrical energy. This leads to environmental pollution. An increase in thermal efficiency of the MHD electric power plant is accompanied by a reduction in heat liberation and this means less atmospheric pollution.

"Furthermore, MHD electric power plants will have a technical system for cleansing combustion by-products of elements which pollute the air. Let me give a concrete example. In the device there is an ionizing additive for increasing electrical conductivity of the plasma. So this additive combined well with sulfur. Hence there is a reduction in the sulfur content of waste products to a minimum. On the whole, the wide introduction of a new trend in energy will aid in solving environmental problems.

It goes without saying that MHD electric power plants can not be viewed as a panacea for all the problems related to solving the energy problem. But the MHD Method will hold a worthy place with the advanced methods of energy production.

[14-8617]

8617

CSO: 1861

ADVANCES IN NUCLEAR FUSION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 Dec 79 p 2

[Article by G. LOMANOV, special correspondent: "A 'Lock' for a Reactor"]

[Text] The "Ogra-4" fusion facility has been started up at the I. V. Kurchatov Nuclear Power Institute.

Controlled thermonuclear fusion. A ray of hope in the gathering gloom of the energy crisis that threatens mankind. A very complicated problem with various roads leading to the solution. But on every road there are three barriers.

Temperature. Time. Density. The plasma must be heated to superstellar temperatures, compressed to the required density, and maintained in this state for a definite time. Only then does the fusion reaction start. These barriers are very high.

One of the major problems is how to contain the hot thermonuclear plasma. Soviet physicists have proposed the idea of suspending the plasma cloud in a magnetic field. This is the idea that has been realized in the widely known tokamaks and in facilities of the "ogra" type. There is an essential difference between them: the field force lines in tokamaks are enclosed in a torus -- a vacuum chamber resembling a doughnut; in the "ogra" the force lines go beyond the walls of the chamber, and therefore facilities of this type are called "open." The concept of open traps was suggested by Academician G. I. Budker, and the first "ogra" was built under the direction of I. V. Kurchatov.

The exotic name is simply explained: physicists had the goal of making a facility that could produce One GRAM of neutrons in 24 hours. Hence the name "OGRA." So far, no one has been able to achieve a neutron flux of such intensity. The Ogra-4 could produce about a hundred thousandth of that amount.

"It could, but there is no need," explains Professor I. N. Golovin, department head of the institute. "The neutrons would demand protection from radiation, serious precautionary measures. All this reduces the

efficacy of research. And we didn't make the [Ogra] 'four' to produce neutrons, but rather to thoroughly study the laws of plasma containment and to master those laws..."

The Ogra-4 is in essence a "lock" for a thermonuclear reactor. A new form of such a reactor has been proposed by a group of Novosibirsk physicists headed by G. I. Dimov. The design is simple: a chain of three open traps of the "ogra" type; one long one in the middle and two smaller ones on the ends. This is a very advantageous configuration: a thermonuclear reaction is achieved with much greater power than in three isolated traps with the same inputs for plasma heating. However, the parameters of such a reactor depend primarily on whether both ends are well "blocked." This is why the Ogra-4 was created to study the operation of magnetic "locks."

We arrived at the institute several hours before startup. While the laboratory workers were doing last-minute tests under the direction of Candidate of Physical and Technical Sciences D. A. Panov, we were introduced to the "four" by Chief Lab Engineer A. A. Tereshkin. The design embodies many original and intricate engineering advances. And it wasn't at all easy to work at a stepped-up pace with the blueprints going straight from the drawing board to the shops and the construction site.

"The heart of the facility is a five-ton superconducting magnet enclosed in a cryostat with liquid helium," Tereshkin told us. "The winding of the magnet operates at a temperature of only four degrees above absolute zero. And right next to it in the center of the trap is a plasma heated to one-hundred thirty million degrees. How do we separate cosmic cold from stellar heat? Here every step is a problem. Inside the chamber is an ultrapure vacuum: only three thousand atoms in every cubic centimetre. This is at the limit of present capabilities. And this vacuum is produced not in a small space, but in a large chamber full of complex stuff. To make a long story short, the engineers have had their day, and now it's time for the physicists."

For a long time the tokamaks have been the world leaders in the fusion program, and the development of open traps has not been considered very promising. Only comparatively recently has considerable progress been shown here as well, thanks to advances in plasma theory and engineering breakthroughs. It was this that was emphasized by President of the USSR Academy of Sciences A. P. Aleksandrov in congratulating the scientists, engineers and millwrights who produced the Ogra-4 facility.

It is still a long way to the goal of One GRAM in 24 hours. But each step brings researchers closer. Let us recall that one of the barriers to fusion is marked "density." Plasma density is half a million times higher in the "four" that is being started up on the eve of 1980 as in the first "ogra" produced in 1958!

[14-6610]

6610

CSO: 1861

BRIEFS

HYDROGEN FUEL--(TASS)--A taxi completed the long trip from Kharkov to Kiev using a gasoline-hydrogen mixture created by scientists of the Institute of Problems of Machine Construction of the Ukrainian Academy of Sciences. The mileage results showed an operating consumption of 40 percent less gasoline, and the amount of exhaust gases was reduced to a minimum. The taxi does not appear outwardly different than most. But the dashboard contains another panel with devices which monitor the operation of a special hydrogen tank in the trunk. Several of these experimental taxis will be put on the roads this year. Work continues on the design of a bus with hydrogen tanks. Transport means will give off clean water instead of exhaust gases along the most revived highway of Kharkov. [Text] [SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Aug 79 no page given] 8617

GIANT TIRES--Leningrad--Imagine automobile tires roughly the height of two men! Giant tubeless tires 3.5 meters in diameter and weighing over 3,000 kilograms, are now being planned by the Leningrad branch of the Rezinoprojekt Institute for the Bobruyskshina Association. The giant tires are intended for superpowerful large cargo 180-ton BelAz dump trucks and production will begin in the next five-year plant. The high reliability of the new items will be guaranteed by superstrong capron with the addition of natural rubber. The tire is over one meter wide and the depth of tread is about 8 centimeters. [Text] [Moscow IZVESTIYA in Russian 18 Jul 79] 8617
[417]

CSO: 1861

BRIEFS

ADVANCES IN INDUSTRIAL MATERIALS--Specialists of the All-Union Scientific Research Institute for Design and Planning of Glass Founding Machinery have recently developed many new machines as well as original equipment for glassmaking. For example colleagues from East Germany are now collaborating with the institute in setting up lines for making pipes of chemically inert borosilicate glass. Such pipes can be used to transport milk, beer, and other liquid and particularly foodstuffs, as well as chemical products. This pipe is 7-8 times less expensive than metal pipe, and lasts nearly ten times as long. [Text] [n.p. SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Dec 79 p 4] Exposing cutting tools to a pulsating magnetic field sharply extends their service life. The result is reduced expenditures of scarce steels, and lower labor inputs in making milling cutters, taps and lathe tools. Equipment based on this principle is being used in industry, the OS-257 facility being outstanding for completeness and simplicity of design. This unit can handle workpieces up to 30 mm in diameter and 200 mm long. [Text] [n.p. SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Dec 79 p 4]
[14-6610]

CSO: 1861

USSR

UDC [621.335:625.2.012.858:538.65]:621.313.13-12

OPTIMIZATION CALCULATION OF A SYSTEM WITH PERMANENT MAGNETS FOR COMBINED
MAGNETIC SUSPENSION OF HIGH-SPEED SURFACE TRANSPORTATION

Novocherkassk IZVESTIYA VUZov: ELEKTROMEKHANIKA in Russian No 6, Jun 79
pp 528-531 manuscript received 31 Mar 77, after revision 1 Nov 78

GALIKYAN, Gennadiy Sarkisovich, docent, KREVCHENKO, Yuriy Rostislavovich, graduate student, PEKKER, Ioel' Iosifovich, candidate of technical sciences, docent, Novocherkassk Polytechnical Institute, NOVOGRENKO, Nikolay Matveyevich, candidate of technical sciences, VELNII [expansion not given], and TKACHENKO, Gennadiy Ivanovich, candidate of technical sciences, Senior Instructor, Novorossiysk Higher Engineering Naval Academy

[Abstract] A method is proposed for calculating the optimum dimensions of a combined U-shaped magnetic suspension with permanent magnets for high-speed surface transport levitation. The proposed technique gives the minimum mass of the system for a given lift, rail width, and given materials of the magnet, armature and rail. The use of a saturable armature of magnetically soft material with maximum rectilinearity of the magnetization curve reduces the steepness of the traction characteristics of these suspension systems, enhancing the stability of the levitation. The use of a material with saturation induction for the armature of the uncontrolled permanent magnets can considerably increase the lift-to-weight ratio of the system. The rail width must be kept smaller than a certain critical value to prevent a sharp reduction in the lift-to-weight ratio. Figures 3, references 5 (Russian).
[481-6610]

CALCULATING THE STEADY-STATE TEMPERATURE FIELD OF A DC HORSESHOE ELECTRO-MAGNET

Novocherkassk IZVESTIYA VUZov: ELEKTROMEKHANIKa in Russian No 6, Jun 79
pp 536-540 manuscript received 18 Dec 78

LOBOV, Boris Nikolayevich, graduate student, Novocherkass Polytechnical
Institute

[Abstract] The paper gives an algorithm and some results of calculation of heating of a DC electromagnet of an experimental model of a high-speed surface transport system with magnetic suspension. It is shown that numerical methods can be used to determine the temperature field of a magnet broken up into separate elements. Comparison of an example with experimental results shows that computer modeling can eliminate the need for large volumes of full-scale experiments. Figures 4, references 4 (Russian).
[481-6610]

USSR

UDC 539.185

DETECTORS FOR STUDYING FISSION NEUTRONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 3, Sep 79 pp 172-176 manuscript received 17 May 78, after revision 17 Nov 78

ALEKSANDROV, Z. A., BOL'SHOV, V. I., BOCHAROVA, I. YE., VOLODIN, K. YE., NESTEROV, V. G., PROKHOROVA, L. I., SMIRENKIN, G. N. and TURCHIN, YU. M.

[Abstract] Research results are given on some new possibilities for measuring the characteristics of fission neutrons by the macroscopic detector method. Three modifications of the technique are considered: a macroscopic fast neutron detector (E-detector), the method of simultaneous measurements of the average yield and average energy of fission neutrons (ν E-detector), and a detector for measuring $\bar{\nu}$ that is insensitive to the mean energy of the fission neutrons (ν detector). While the proposed methods were developed for the purpose of studying fission neutron spectra, they can be extended to other problems as well. For example a 4π -detector analogous to the one described in this paper has been used to separate prompt and delayed fission neutrons, (γ, f)- and (γ, n)-neutrons. The macroscopic spectrometer method is most effective in situations where the energy distribution can be represented in a conveniently parametrizable form, but it is not at all limited to such situations. In the general case, the problem is solved by using a group description of distributions, and comes down to solution of a system of linear equations with experimentally determined left-hand members \hat{M}_n .
[425-6610]

USSR

UDC 539.124.6

USING A CRYSTAL SYNCHROTRON TARGET TO GET A POSITRON BEAM

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 3, Sep 79 pp 188-189 manuscript received 31 Jul 78, after revision 6 Feb 79

POTEMKIN, V. G. and VOROB'YEV, S. A.

[Abstract] Interference phenomena can be observed when a sufficiently high-energy electron beam interacts with a single crystal oriented in a certain way. This effect can be used to enhance the intensity of a positron beam with angle of divergence smaller than for the critical channeling angle. In this connection, experiments were done on the effect that the form of the energy spectrum of a collimated beam of

synchrotron bremsstrahlung quanta has on the doubly differential positron yield of an amorphous converter. The bremsstrahlung beams were produced by tantalum and diamond targets exposed to an electron beam in the Sirius synchrotron. Positrons were generated by the bremsstrahlung quanta in copper converters. The experiments showed that a positron beam can be produced in a predetermined range of angles and energy with degree of monochromaticity and intensity determined by the corresponding parameters of the first interference maximum. The position and intensity of the positron peak can be varied by changing the angles of orientation and the thickness of the single crystal without altering the parameters of the electron beam that generates the coherent bremsstrahlung. The authors thank Professor A. N. Didenko and Senior Scientists V. M. Kuznetsov for providing the opportunity to make the measurements. Figures 2, references 5 (Russian).
[425-6610]

USSR

UDC 621.039.514

A REACTIMETER WITH PULSED MEASUREMENT CHANNEL

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 3, Sep 79 pp 202-203 manuscript received 23 Oct 78

LYSTSOV, V. N. and KNIZHNIKOV, V. A.

[Abstract] The article describes a pulsed measurement channel for measuring low subcriticalities based on a high-efficiency counter and a linear intensimeter. This channel can measure subcriticalities corresponding to a count rate range of 100-10,000 pps. The input signal is a random sequence of pulses that corresponds to the number of registered neutrons per unit of time, and the output signal is a voltage proportional to the count rate. Measurement results of the proposed reactimeter are given. The authors thank Yu. A. Prokhorov for continued interest in the work, and also R. E. Bagdasarov, V. I. Kozlov and Yu. V. Volkov for assistance with the experiments and discussion of the results. Figures 2, references 6: 5 Russian, 1 Western.
[425-6610]

PROBLEMS OF OPTIMIZING THE PLASMA PARAMETERS OF A HYBRID TOKAMAK REACTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 6, Dec 79 pp 374-377 manuscript received 14 Feb 79

KUKUSHKIN, A. S. and PISTUNOVICH, V. I.

[Abstract] Recently published calculations of the parameters of tokamak fusion reactors relate mainly to parametric analysis of systems rather than to closed models of the reactor. The lack of a reliable model for calculating plasma parameters can be attributed to inadequate understanding of the behavior of plasma under reactor conditions. Nevertheless, currently available information gives some important clues about optimum plasma parameters. This article gives data on optimum reactor dimensions and working conditions implied by simple equations of the balance of energy and particles in a tokamak plasma, and numerical calculations done with the aid of the extended plateau model for ionic heat conduction. An examination is also made of the influence that corrugation of the toroidal magnetic field has on the energy balance of the plasma. It is concluded that there is an optimum size for the plasma of a hybrid tokamak reactor that is apparently determined by the thickness of the blanket, the magnetic coils and so on, and consequently by the economic indices of the system as a whole. Further progress in the development of the tokamak reactor will depend on advancement of the limiting pressure where the plasma still remains stable. Corrugation of the toroidal field should not exceed +1%. Figures 5, references 13: 6 Russian, 7 Western.
[9-6610]

TEMPERATURE DISTRIBUTION IN THE FUEL CORE AND CLADDING IN THE CASE OF RADIANT HEAT EXCHANGE BETWEEN THEM

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 6, Dec 79 pp 410-413 manuscript received 13 Jan 79, after revision 12 Mar 79

KUZNETSOV, V. F.

[Abstract] An analysis is made of the fine structure of the temperature field in the cross section of a fuel element due to nonuniformity of energy distribution. It is assumed that the core and cladding are separated by a vacuum gap with heat exchange by Stefan-Boltzmann law over the surfaces. Heat is removed from the outer surface of the cladding in accordance with a predetermined nonlinear law. A system of boundary

value problems is formulated and solved by division into two stages: determination of the surface temperatures, and calculation of the temperature field inside the core and shell. The proposed method can be applied to analysis of temperature fields in fuel elements with nonuniform energy distribution and nonlinear boundary conditions. The authors thank V. A. Lobintsev for assistance and Ya. V. Shevelev for constructive criticism. Figures 2, references 4: 3 Russian, 1 Western.
[9-6610]

USSR

UDC 621.039.556

A HOT NEUTRON GENERATOR WITH A ZIRCONIUM HYDRIDE RETHERMALIZER

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 6, Dec 79 pp 412-413 manuscript received 13 Jan 79, after revision 12 Mar 79

POLOSUKHIN, B. G., CHUDINOV, V. G., GOSHCHITSKIY, B. N., GUSEV, V. V. and MESROPOV, M. G.

[Abstract] Rethermalizer materials in currently used hot neutron generators are generally graphite, beryllium and beryllium oxide in the form of blocks 110-200 mm in diameter and 100-300 mm long at a temperature of 800-2000°C. The increase in the hot neutron flux with these rethermalizers amounts to a factor of 3-7. The use of zirconium hydride in rethermalizers should be more effective with smaller dimensions of the blocks, and hence closer location to the reactor core. However, this material cannot be heated beyond 700-800°C without additional measures to keep the hydrogen bound in the hydride. This paper describes the results of tests of hot neutron generators with a rethermalizer made of $ZrH_{1.7} + 1\% Nb$. It is found that the hot neutron yield can be increased by a factor of 3.2 as compared with an empty channel for an energy of about 0.2 eV. The ratio of intensity of useful neutrons over the background level is about 6-10 at an energy of 0.2-0.25 eV. The authors thank V. P. Panyushin and V. I. Savin for taking part in the work. Figures 2, references 5: 1 Russian, 4 Western.
[9-6610]

EXPERIMENTAL BASE FOR SIMULATING RADIATION ACTING ON SPACE MISSIONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 6, Dec 79 pp 418-420 manuscript received 23 Mar 79

VOROB'YEV, YE. I., KOVALEV, YE. YE., SAKOVICH, V. A., SERBINOV, A. N., BRILL', O. D., GRIBOV, B. S. and ZABOROVSKIY, YU. I.

[Abstract] One of the specific problems of space missions is to ensure radiation safety from cosmic rays and nuclear emissions of facilities on board the spacecraft. This involves setting normative levels of radiation with regard to formation of the tissue dose of cosmic rays and the particulars of biological action, development of spacecraft shielding with minimum mass for all kinds of radiation, development of methods for measuring cosmic ray doses on the spacecraft, preparation and additional measures during and after a mission with consideration of the actual and predicted radiation environment up to and including the use of pharmacological protection where necessary. This paper describes an experimental support base for research on radiation safety in planning space missions. The complex includes an SVV-1 nuclear reactor, a B-5 proton accelerator with beam separation system, two Almaz gamma facilities and three Topaz gamma units. The B-5 unit is a synchrotron that produces both protons and multiply charged ions with continuous energy control for 20-200 MeV protons and a wide range of ions up to a maximum energy of 50 MeV/nucleon. The SVV-1 facility has a vertically movable core with 500 kW power. Diagrams of the experimental installation are presented showing the plan and elevation views. The proposed complex can simulate any expected radiation and environment on a space mission. Figures 3, references 4 (Russian). [9-6610]

SELF-START OF ELECTRIC MOTORS FOR STATION AUXILIARIES IN ATOMIC ELECTRIC POWER PLANT WITH RBMK-1000 REACTORS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 12, Dec 79 p 14

GEORGIADI, V. KH., engineer, and YUKOV, E. M., engineer, All-Union Engineering Administration of Power System Management

[Abstract] In response to the article on this subject by A. P. YEGERIN, S. F. MOKEYEV, G. V. MERKUR'YEV and others (ELEKTRICHESKIYE STANTSII, No 2, 1979), who propose to depend on design calculations only without testing, it is pointed out here that the self-start of electric motors

for station auxiliaries in atomic electric power plants must be checked experimentally. Although testing of electric motors for self-start is difficult generally, in atomic electric power plants it is absolutely necessary. Firstly, because the accuracy of computer calculations depends on the mathematical model and on the catalog input data, which to various degrees differ from actual performance characteristics and cannot possibly account for all factors affecting the self-start. Secondly, unlike in fossil-fuel plants, in atomic electric power plants even during short shutdowns the technological conditions can change enough to cause speed-related instability and a drop in power available for self-start of electric motors. Self-start can only then be regarded as proceeding successfully, if the main generator has not been protectively shut down during failure and recovery of the generator energizing the electric motors for station auxiliaries. References 3 (Russian).
[8-2415]

USSR

UDC 621.165:621.3.078

FEATURES OF OPERATION OF THE AUTOMATIC CONTROL SYSTEM OF THE K-300-240
KHTGZ TURBINE UNDER HIGH PERTURBATIONS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 8, Aug 79 pp 36-39

ROKHLENKO, V. YU., candidate of technical sciences, and RUDNITSKIY, G. M.,
engineer, Khar'kov Turbogenerator Plant imeni S. M. Kirov

[Abstract] Research of prototype automatic control systems of the K-300-240 and K-500-240 turbines of the Khar'kov Turbogenerator Plant carried out at electrical power plants to test their conformity to new requirements of maneuverability revealed the need to revise some design decisions, chiefly, linearization of the pulse diagram and total opening of valves under nominal pressure. The methods devised to study the dynamics of the automatic control system made it possible to determine modernization trends, e.g., elimination of cross connections, reduction of lack of dynamic compensation, reduction of travel time for cut-off valves to open, etc. Tests of the modernized system showed the effectiveness of changes. The pulse diagrams obtained in tests of the modernized system are more linear and are displaced toward higher values of signal width with a simultaneous reduction in time to reach minimum power. Figures 6; references 2 (Russian). [412-8617]

USSR

UDC 621.313.322-82.043.2.017.71

CALCULATING THE TEMPERATURE RISE IN THE END STACKS OF STATOR CORES OF LARGE
HYDROELECTRIC GENERATORS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 12, Dec 79 pp 28-30

EL'BERT, YE. S., engineer, Ural Heavy Electrical Machinery Plant

[Abstract] Calculations are shown on the basis of which the temperature rise in critical spots of stator cores of large hydroelectric generators can be predicted. Experimental studies indicate that the temperature rise is highest in the teeth of a few end stacks, during periods when the active power remains nearly nominal but reactive power is also drawn. The heating is due to fan losses, due to the radial main magnetic flux in the stator core and due to the current in the stator coils, also due to the axial magnetic flux produced by fringing and leakage. The last component of the temperature rise is calculated with the aid of vector diagrams for a synchronous machine, reactive power being drawn in the case of either under- or overexcitation, and assuming the temperature rise to be proportional to the magnetic induction squared. The necessary data can be obtained

from short-circuit and open-circuit tests, the latter being especially important for determining the full-load heating. Typical radial profiles of the temperature rise in the stator end stacks of 240 MW and 300 MW generators are shown, the magnitude of the temperature rises throughout and the peaking of the profile depending on the terminal voltage as well as on the power factor of the load. Figures 3; reference 1 (Russian). [8-2415]

USSR

UDC 621.314.726

A RESONANCE TRANSFORMER WITH SMOOTH REGULATION

Moscow ELEKTRICHESKIYE STANTSII in Russian No 12, Dec 79 pp 57-59

VOSKRESENSKIY, A. A., engineer, and MALYUSHITSKIY, G. P., engineer, Gor'kiy Regional Administration of Power System Management; SEREBRYAKOVA, YE. N., candidate of technical sciences, Gor'kiy Polytechnic Institute

[Abstract] A variable-voltage transformer for high-voltage testing of cable insulation is described which operates on the principle of resonance between the source inductance and the load capacitance. It has a shell construction, with the low-voltage primary winding on top of the high-voltage secondary winding. Smooth regulation of the output voltage is made possible with the aid of the same main closed magnetic circuit which couples both windings, namely by moving the primary coil and thus varying the leakage inductance of the transformer. This is done through a gear mechanism, either manually or remotely. The principle is explained with the aid of equivalent circuit diagrams. The performance is demonstrated on curves of cable voltage and cable current as well as fault current and fault power as functions of the contact resistance at the fault location, for two typical values of the capacitance, both the cable current and the fault power dipping sharply at $10^4 \Omega$ in each case. Figures 3; references 6 (Russian).

[8-2415]

PUTTING THE GT-100-3 GAS-TURBINE FACILITY TO PRACTICAL USE

Moscow ENERGETIK in Russian No 10, Oct 79 pp 1-2

PTITSYN, G. V., engineer, State Regional Electric Power Plant No 3, Elektrogorsk

[Abstract] The article gives data on the GT-100-3 gas turbine facility installed to cover peak loads at the Klasson State Regional Electric Power Plant No 3 of the Mosenergo Power Grid. The first turbine was installed at the power plant in January 1977, the second was installed in November 1978, and the third was planned for 1979. The GT-100-3 facility operates on an open cycle with two-stage compression, intermediate air cooling and two-stage combustion without regeneration. The unit has a two-shaft arrangement with the low-pressure compressor and low-pressure turbine on the shaft with the electric generator. The shaft speed is constant at 3000 rpm in all operating modes. The high-pressure turbine and high-pressure compressor are on a free-running shaft that is not under load and can turn at different speeds during operation of the facility. Rated power is 100 MW, and efficiency is 28%. The GT-100-3 covers peak loads from September to May on working days in the morning and evening hours of maximum load. Figure 1.

[479-6610]

DIGITAL SIMULATION OF TRANSIENT PROCESSES IN A SELF-CONTAINED GENERATOR-INDUCTION MOTOR SYSTEM WITH ALLOWANCE FOR SATURATION OF ITS MAGNETIC CIRCUITS

Novocherkassk IZVESTIYA VUZov: ELEKTROMEKHANIKa in Russian No 10, 1979 pp 880-887 manuscript received 22 Feb 78; after editing 24 Jan 79

BUDISHCHEV, M. S.

[Abstract] A digital model for the analysis of transient processes in the generator-induction motor system with allowance for the saturation of the magnetic circuits of both machines is described. The model is based on the notation of the pertinent equations in d,q-axes and a nonlinear solution of the problem of total interlinkage, with the partial derivatives of current interlinkages being determined as a function of the magnetization of discrete sectors of the magnetic circuits. This makes it possible to determine all the coefficients of the nonlinear system of differential equations describing the generator and motor and to perform integration of

that system by a computerized numerical method. The algorithm presented was used to analyze transient processes at start-up of an A61/4 type 10 kW motor and an MSA72/4 type 12 kW generator, and the findings were in agreement with the theory. The proposed digital model of the generator-induction motor system makes it possible to analyze its transient processes with allowance for the actual magnetic state of the machines while also taking into account several other interdependent factors. Figures 3; references 6 (Russian).
[4-1386]

USSR

UDC 621.313.332

SINGLE-PHASE INDUCTION GENERATOR WITH THYRISTORIZED VOLTAGE CONTROL

Novocherkassk IAVESTIYA YUZov: ELEKTROMEKHANIKA in Russian No 10, 1979
pp 888-892 manuscript received 17 May 78; after editing 21 Feb 79

SHUMOV, YU. N.

[Abstract] Normally the use of thyristors for voltage control in induction generators is restricted by such shortcomings as a marked distortion of the voltage curve and the need for series connection of current limiters of considerable weight and dimensions. These disadvantages are precluded by the new method presented here. The method consists in generating a demagnetizing magnetomotive force (mmf) either by means of an additional winding shifted through 90 el. degrees in relation to the main winding, or by connecting the thyristors to the stator winding leads so that the mmf generated by the inductive current of the thyristors would be displaced through 90 el. degrees relative to the magnetizing mmf generated by the capacitive current of the setup. Eight different circuit of a single-phase induction generator based on this method are proposed. These circuits assure an improved shape of the output voltage in the presence of thyristors, a broad range of voltage control, and the elimination of the current-limiting coil. Laboratory tests show that the proposed method of voltage control is fast-acting, assures a more than 1:10 range of voltage control, and assures a high quality of output voltage (the distortion factor of the sine-waveform of the curve is then as low as 1.01-1.05). Figures 4; references 7: 4 Russian, 3 Western.
[4-1386]

THE OPTIMUM DEGREE OF REGENERATION IN THE GAS TURBINE POWER PLANT CYCLE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian
No 5, 1980 pp 71-73 manuscript received 19 May 78

LAPIN, YU. D.

[Abstract] The optimum degree of heat regeneration in the gas turbine power plant cycle was determined analytically with the assumption of constant thermophysical properties and mass consumption of the working body through the power plant channel. The optimum degree of regeneration can be calculated by using the derived analytical formulas.

USSR

UDC [621.643.002.2]62.001.6

SCIENTIFIC PROBLEMS IN THE CONSTRUCTION OF NORTHERN PIPELINES

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 8, Aug 79 pp 10-15

IVANTSOV, O. M., Ministry of Petroleum and Gas Construction

[Abstract] The author discusses the problems of pipeline transport of liquid hydrocarbons in large amounts over long distances. Because of the increased costs of long-distance pipeline transport, efficiency and reliability determine the technical and economic policy and the strategy of pipeline construction in the North. A general theory of reliability of pipelines is needed to improve the effectiveness of engineering steps that are taken in pipeline construction. Development of such a theory would enable proper evaluation of the influence of gas transport parameters, ambient conditions, and the probability of overlapping of different factors. It would then be possible to predetermine the level of reliability and the fail-free service life of the system. Improvements are needed in the present methods of strength calculations. The interaction between pipelines and various kinds of soils has not been adequately studied. Pipeline reliability could be considerably improved by using systematic testing of materials and equipment. Specific recommendations are made on improving pipeline construction under permafrost conditions, in river crossings, on swampy terrain and in rocky soil. Considerable work is now being done to mechanize heavy work and automate welding.

{424-6610}

USSR

UDC 621.643.002.2

USE OF MOVABLE-VANE PIPELINE ANCHORS

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 11, 1979 pp 16-18

POSTNIKOV, V. V., TROFIMOV, A. S. and KULIKOV, I. V., Tyumen', Glavsibtruboprovodstroy [Main Siberian Pipeline Construction Trust]; Moscow, MINKh and GP [Moscow Institute of Petrochemical and Gas Industry imeni I. M. Gubkin]

[Abstract] Movable-vane pipeline anchors, whose vanes unfold in the horizontal direction so as to assure improved anchoring of the pipeline to the soil following the installation of the anchors in the soil, are widely used in West Siberian pipeline construction. In this connection the optimization of the anchor-installing operations under West Siberian soil and climate conditions is discussed. Several possible variants of anchoring operations are considered, as based on the use of either regular pile-driving machinery- or the AR-401 special anchor-sinking machine. The best

variants are those based on the idea of sinking the anchors and unfolding their vanes prior to the excavation of the pipeline trench and the laying of the pipe, in view of the difficult natural conditions of West Siberia which preclude the combining of the anchoring, excavating, and pipe-laying operations, given the presence of frozen moisture-laden soils and the low readiness coefficient of pile-driving and excavating machinery in that climate. Figures 3.

[5-1386]

USSR

UDC 621.311:62-52

RESULTS OF EXPERIMENTAL OPERATION OF THE PROGRAM PACKAGE OF THE AUTOMATED TECHNOLOGICAL PROCESS CONTROL SYSTEM OF THE 800 MW POWER UNIT AT THE UGLEGORSK STATE REGIONAL ELECTRIC PLANT

Moscow ENERGETIK in Russian No 7, July 79 pp 17-18

ABROSIMOV, B. R., engineer, Dontekhenenergo, Gorlovka

[Abstract] In December 1977, Dontekhenenergo put a set of algorithms and programs into experimental-industrial operation on the first phase of the automated technological process control system of the 800 MW power unit at the Uglegorsk State Regional Electric Plant. The results confirm the correctness of the decision to base the system on magnetic disk accumulators as the main data media. During the period of experimental-industrial operation, corrections were made in the algorithms, and additions were made to the programs for checking the reliability of initial information, calculating and analyzing the thermoelectric index and registering emergency situations in the power unit.

[480-6610]

USSR

UDC 62-5

ANALYTIC DESIGN OF INDUSTRIAL ROBOT DRIVE CONTROL SYSTEMS

Novocherkassk IZVESTIYA VUZov: ELEKTROMEKHANIKA in Russian No 10, 1979 pp 925-930 manuscript received 3 Nov 77; after editing 16 Apr 79

ZHILYAKOV, V. I.

[Abstract] The problem of the synthesis of control systems optimal with respect to the Lyapunov functional is considered in relation to the design of industrial robots. The optimal algorithm is realized on the basis of Lyapunov's concept of perturbed-unperturbed motion. Then both linear and relay systems are realized as two-level hierarchic control systems. The first level of the hierarchy generates the motion which Lyapunov terms unperturbed, that is, it generates the desired values of the coordinates in the transient and steady-state modes. The second level of the hierarchy (the controller proper) computes the coordinates of perturbed motion and generates the control action. The optimization of the first level is not an analytic design task and can be solved by any method of synthesis on proceeding from the desired quality of control. The optimization of the second level is a task of analytic design and its solution should assure a minimum of the optimality criterion for the desired motion of the system. Figures 5; references 5 (Russian).

[4-1386]

COORDINATE STABILIZING SYSTEM FOR INDUSTRIAL ROBOTS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 11, 1979 pp 7-9

KORLYAKOV, V. K.

[Abstract] A major problem in the design of electrically operated industrial robots is the selection of braking devices serving to maintain the manipulated object in a fixed position. The use of friction-braking devices adds too much to the mass and dimensions of the drive and causes deviations from the fixed position. It is thus preferable to use coordinate-setting servomechanisms controlling the movements of the robot. A functional diagram of the pertinent stabilization system is presented and described. It is chiefly based on the use of a computer for recording coordinate increments and another (control) computer for feeding signals to the servomechanism unit, with feedback adjustments. Differential equations describing the performance of the system are presented and analyzed. The system serves not only to control the drive motor and maintain a fixed value of movement coordinates but also to use the drive motor for both moving the robot and restoring the set position of the robot in the event of an overshoot. This system illustrates the considerable potential of the use of computers in the control systems of industrial robots, and particularly the attendant possibility of simplifying robot design and relaxing the requirements as to the precision of manufacturing discrete robot components. Figures 2; references 3: 2 Russian, 1 Western. [11-1386]

USSR

UDC 539.4:621.313.222-81-251

DURABILITY STUDIES ON MODULAR ROTORS OF TURBOGENERATORS IN LARGE-SCALE SIMULATION

Moscow ENERCOMASHINOSTROYENIYE in Russian No 6, Jun 79 pp 2-6

KUDRYAVTSEV, I. V., doctor of technical sciences, professor; and
NAUMCHENKO, N. YE., candidate of technical sciences

[Abstract] With the increase in unit output of generators to 800-1200 MW it is becoming extremely difficult to manufacture large rotors for them in a single forged form. New designs and technologies are being used which are based on modular, welded or welded-modular rotor manufacture. The Central Scientific-Research Institute of Turbine Machinery has done a great deal of research into assuring the necessary durability for large modular rotors with the aid of large-scale simulation methods. Experimental research on the stressed state and durability of large sectional rotor models showed it is theoretically possible to build the powerful four-pole rotors in the modular form. The results are being used to optimize designs and have been directly adopted by industry to produce 50 and 500 MW generators with four-pole rotors. Figures 3; references 5 (Russian).
[413-8617]

USSR

UDC 621.165.539.6

TURBINE-STAGE LOSS DUE TO LASHING WIRE

Minsk IZVESTIYA VUZov: ENERGETIKA in Russian No 7, 1979 pp 51-57
manuscript received 13 Nov 78TERENT'YEV, I. K., MARCHENKO, YU. A., LAPIN, N. V. and BAZAROVA, L.P.,
Scientific Production Association for Power Station Equipment R&D

[Abstract] Lashing wire is widely used to improve the vibration characteristics of turbine rotor blades. However, it has an adverse effect on the aerodynamic characteristics and operating economy of the turbine stage. This question is now investigated in detail with respect to the last three stages of the low-pressure part of a newly designed heavy-duty cross-compound steam turbine. Analysis of the experimental findings shows that the gas-dynamic drag due to lashing wire is equivalent to the drag of a cylinder placed in a straight tube. Removal of lashing wire from the flow-through area definitely contributes to improving turbine operating economy, and practical experience demonstrates the feasibility of this measure. In this connection, it is important to develop design solutions providing either for turbine stages without lashing wire or for transferring lashing wire to a specially designed shroud. Figures 3; references 3 (Russian).
[498-1386]

ON THE OPTIMIZATION OF TURBINE BLADES

Minsk IZVESTIYA VUZov: ENERGETIKA in Russian No 7, 1979 pp 106-108
manuscript received 16 Mar 79

GRECHANICHENKO, YU. V. and BURLAKA, V. V., Khar'kov Order of Lenin
Polytechnic Institute imeni V. I. Lenin

[Abstract] It is shown that the optimization of turbine blade design can be advanced if treated as a computer-solved nonlinear programming problem. The optimization of the design of the moving and nozzle blades of high-capacity turbines is considered. Calculations of blade-tip loss in relation to boundary-layer flow are found to be in good agreement with experiment not only for convergent-nozzle blades but also for impulse blades. The optimization of a turbine blade should, particularly at $b/l > 1$, allow for blade-tip loss, i.e. the criterion functional should be the integral efficiency of the cascade, since the profile assuring minimum profile losses may be far from optimal for a short blade. The computational findings confirm the expediency of using convergent-divergent profiles for impulse-type blades. The optimum can be determined by means of a computer for every concrete distribution of parameters over the radius of a blade of specific height and chord. Figures 2; references 3 (Russian).
[498-1386]

DESIGN OF AXIAL-FLOW PUMP IMPELLER BASED ON THE SOLUTION OF THE CONVERSE PROBLEM OF THE CASCADE THEORY

Minsk IZVESTIYA VUZov: ENERGETIKA in Russian No 8, 1979 pp 71-75 manuscript received 22 Mar 79

BIRYUKOV, A. I., KOCHESKIY, N. N., All-Union Scientific Research and Project-Design Institute of Atomic and Power Station Pump Building and KOSTORNYI, S. D., Sumy Affiliate of the Khar'kov Polytechnic Institute imeni V. I. Lenin

[Abstract] The impeller system of an axial-flow pump was experimentally designed with the aid of the steep-ascent method for planning extremal experiments, on the basis of selected representative optimization parameters. The method for solving the converse problem was so developed that the cascade solidity would not be part of the input data but rather would

be determined as a result of the solution. The effect of various factors on the representative optimization parameters was analyzed from the standpoint of assuring a high cavitation resistance of the cascade of blades. The expediency of using the steep-ascent method in the design of the impeller systems of axial-flow pumps on the basis of the solution of the inverse problem is thus demonstrated, since then it is possible to estimate the effect of discrete influencing factors and determine the optimal cascade design on the basis of a reduced volume of computations. Figures 4; references 7 (Russian).
[499-1386]

USSR

UDC 62-505.32

OPTIMIZATION OF MAGNETIC SUSPENSION STABILIZING SYSTEM

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979
pp 53-57 manuscript received 16 Oct 78

VORONKOV, V. S. and POZDEYEV, O. D., Scientific Research Institute of Applied Mathematics and Cybernetics at Gor'kiy State University imeni N. I. Lobachevskiy

[Abstract] A stabilization system, needed to assure stability of contact-free equilibrium position of a ferromagnetic body in a magnetic field, is a component part of magnetic suspensions. In this connection, an optimal magnetic suspension stabilizing system is constructed. The optimality criterion selected is the minimum of the integral estimate of the transient process in the presence of perturbations in the form of arbitrary input conditions. The minimization of the corresponding functional is performed by the classical methods of the calculus of variations. In the resulting stabilization system, whose block diagram is presented, the electromagnet voltage is adjusted by signals from a sensor with corrections for the rate of travel of the suspended body. Figures 3; references 4: 3 Russian, 1 Western.
[12-1386]

USSR

UDC 531.383

LEVELING AND DIRECTIONAL ADJUSTMENT OF A GYROSTABILIZED PLATFORM WITH THE AID OF SUBOPTIMAL FILTERS

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979
pp 61-65 manuscript received 7 Feb 79

KOROLEV, G. S. and TYUMENEVA, G. V., Leningrad Institute of Aviation Instrument Making

[Abstract] The utilization of certain suboptimal filters in the leveling and directional adjustment of a gyrostabilized platform is investigated. Such filters, which represent simplified versions of the Kalman filter, eliminate the ponderous matrix operations associated with the Kalman filter and requiring a large direct-access computer memory, by making an allowance for all the component vectors of state of the system without adding them to the number of the parameters estimated. Equations of motion of the system are presented, and the comparative accuracy of the suboptimal filters is estimated through simulation on an M-220M computer and found to be satisfactory. The corresponding suboptimal filtration algorithm is analyzed, and it is shown that a virtually optimal adjustment of the gyrostabilized platform is accomplished. Figures 3; references 2 (Russian).
[12-1386]

OPTIMAL STABILIZATION OF THE ROTARY MOTION OF A GYROSTAT

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 779-786 manuscript received 5 Jul 78

GORSHKOV, A. V., Sverdlovsk

[Abstract] A study is made of an axisymmetrical gyrost at with three fly-wheels moving in a central Newtonian force field. The relative motion of the gyrost at is studied without considering its influence on the movement of the center of mass, which is considered fixed. Figure 1; references 4 (Russian).
[486-6508]

ERROR OF A DYNAMIC TUNABLE GYROSCOPE UPON ANGULAR VIBRATION OF THE BASE

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 10, Oct 79 pp 133-137
manuscript received 9 Feb 78

ZBRUTSKIY, A. V., PAVLOVSKIY, M. A. and SHABAYEV, V. I., Kiev Polytechnical
Institute

[Abstract] A study is made of the peculiarities of behavior and error in a nonlinear model of a dynamically tunable gyroscope upon elastic vibration of the base for both primary and combination resonances. The influence of imperfect elasticity of the material of the support springs on the dynamics of the gyroscope is also studied. Friction, both hysteresis and viscous, decreases the error and is the main factor limiting the maximum error in cases of dynamic instability of the system. The nonlinearity of the equations reflecting the specifics of the kinematic system and the effect of the moments of the force of hysteresis friction results in displacement of the maximum values of error into areas of nonzero frequency mismatch. Figures 3; references 8: 7 Russian, 1 Western.
[488-6508]

INFLUENCE OF RANDOM PERTURBATIONS ON THE MOVEMENT OF A RELAY STABILIZATION SYSTEM

Moscow VESTNIK MOSKOVAKOGO UNIVERSITETA SERIYA I MATEMATIKA MEKHANIKA in Russian No 4, Jul/Aug 79 pp 69-72 manuscript received 7 Feb 78

TIKHOMIROV, V. V., Department of Applied Mechanics

[Abstract] A study is made of the movement of a relay system for stabilization of the angular position of a spacecraft in which the relay element is a part of a system with feedback with delay. The influence of small perturbations in the angle data transmitter on the accuracy of stabilization and the probability of disruption of the most economical stabilization load are studied. Figures 3; references 6 (Russian).
[483-6508]

USSR

UDC 532.542.4

INFLUENCE THAT INPUT CONDITIONS HAVE ON THE DEVELOPMENT OF TURBULENT FLOW LENGTHWISE OF CIRCULAR PIPES

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 3, Sep 79 pp 167-169 manuscript received 29 Sep 78

GABRIANOVICH, B. N., LEVCHENKO, YU. D., TRUBAKOV, YU. P. and USHAKOV, P. A.

[Abstract] The paper generalizes available material and presents new experimental data on the region of hydrodynamically unstabilized flows of coolant in reactor cores and heat exchangers as a function of input conditions. Experiments are done on the turbulent flow of air in the inlet section of a circular pipe 145 mm in diameter at a Reynolds number of 285,000. The axial velocities and turbulent pulsations are measured for different conditions of input. It is shown that when the velocity profile is flat at the inlet to the pipe, the nature of the flow is unaffected by a change in turbulence intensity from 0.7 to 2%. With a change in turbulence intensity from 2 to 7%, the length of stabilization of the velocity profile is cut approximately in half. Experiments show the extent to which various deformations of the velocity profile at the pipe inlet with low input flow turbulence influence the evolution of flow along the pipe. Figures 2; references 15: 10 Russian, 5 Western. [425-6610]

USSR

UDC 537.213+621.319.7.001.24

FIELD POTENTIALS AND FORCES IN A SYSTEM OF THREE CHARGED CONDUCTING SPHERES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA FIZICHESKIKH I TEKHNICHESKIKH NAUK in Russian No 5, 1979 pp 99-104 manuscript received 24 Jan 79

PUTRIN'SH, YU. YU., Institute of Physics, Academy of Sciences of the Latvian SSR

[Abstract] The method of images is applicable to the classical problem in electrostatics of interaction between a finite number of charged conducting bodies. Here the case of three such bodies is considered, each assumed to be a sphere in a system where the shape of the bodies does not play a significant role. They are generally of different sizes and two of them can be assumed to be grounded, with only the surface of one at some given potential. Otherwise the superposition principle applies. Boundary conditions are satisfied by introduction of fictitious charges. Now the electric potential at any point outside the spheres and the

interaction force between "image" charges are expressed in the form of double sums, convenient for evaluation with the aid of the computer. The convergence of these sums according to Leibnitz is tested and the sufficient condition for its established first for the simple case of three spheres with equal radii. As a practical example, this method was used in the case of two oppositely charged spheres of the same size simulating the poles of an electromagnet and pulling in a neutral (uncharged) smaller sphere. Not only the pattern of equipotential surfaces with attendant distortions but also the dependence of this pull force on the distance of the small sphere, with the separation between the two poles as a variable parameter, have thus been determined. When all three spheres are of different sizes, then the conditions for convergence may be less stringent and need to be re-examined. Figures 2; references 6: 3 Russian, 3 Western. [494-2415]

USSR

UDC 532.4

ESTIMATE OF CORRELATION BETWEEN PRESSURE FLUCTUATIONS AND VELOCITY DIVERGENCES IN VARIABLE-DENSITY SUBSONIC FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 4-11 manuscript received 29 Mar 78

KUZNETSOV, V. R., Moscow

[Abstract] For variable-density flow the turbulence energy equation contains a large number of correlations which are relatively uninvestigated. One of the least known of these correlations is the correlation between pressure and velocity divergence. In this connection, fluctuations of the velocity divergence and its correlation with pressure fluctuations in variable-density subsonic turbulent flow are estimated. Three cases are considered: 1) mixing of gases of differing density; 2) diffusion combustion; 3) combustion of a homogeneous mixture. It is assumed that the Mach number is low, the Reynolds number is high, the coefficients of molecular diffusion and thermal diffusivity are equal to one another, and external forces are absent. It is shown that both in the case of mixing in the absence of chemical reactions and in the case of diffusion combustion the correlations between pressure fluctuations and velocity divergence are insignificant. In a diffusion flame the combustion rate is markedly lower than in a premixed flame, and the correlation is low. It appears that a different picture should prevail for the combustion of a homogeneous mixture. References 17: 10 Russian, 7 Western. [484-1386]

USSR

UDC 532.517.4

DECAY OF FLOW TURBULENCE BEHIND A TWIN-ROW CYLINDER GRID WITH EACH ROW
MOVING IN OPPOSITE DIRECTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 3, 1979 pp 17-25 manuscript received 20 Apr 78

GINEVSKIY, A. S., KOLESNIKOV, A. V. and UKHANOVA, L. N., Moscow

[Abstract] Considering that the jet-injection grids used in wind tunnels do not assure sufficiently uniform fields of averaged characteristics, moving rows of cylinders can be instead used as turbulence generators. The first- and second-row cylinders execute translational motion across the flow in the upstream and downstream directions, respectively, at the same rate. By altering the diameters of and distances between the cylinders (rods) it is possible to vary the level of turbulence behind the grid. In this connection, flow characteristics behind such a mechanical turbulence generator in a wind tunnel were investigated. Analysis of the experimental findings shows that the use of the twin-row cylinder grid with one row moving in the upstream direction and the other, in the downstream direction, assures a uniform distribution of mean and fluctuational flow parameters not only at a distance from the grid--as in the case of jet-injection grids--but also in the immediate neighborhood of the grid, where the turbulence levels reach 20-25%. Figures 6; references 17: 5 Russian, 12 Western.

[484-1386]

USSR

UDC 532.525.4

PROBLEM OF MATCHING IN THE THEORY OF INEQUILIBRIUM TURBULENT FLOW NEAR A
WALL

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in
Russian No 3, 1979 pp 33-41 manuscript received 15 Mar 78

LAPIN, YU. V., and YARIN, A. L., Leningrad

[Abstract] The difficulties of an analysis of the available data on inequilibrium turbulent flow near a wall, are pointed out. One reason for these difficulties is the "local" nature of semiempirical turbulence theories. Another reason is associated with the method for matching solutions for the internal and external regions. It is shown that the traditional method of matching solutions according to local values of the coefficients of turbulent viscosity in the internal (wall-effect) and external (wake-effect) regions results in an incorrect determination of

the scale of the internal region. Since turbulent stresses in the external region of inequilibrium boundary layers depend not only on local characteristics but also on the flow prehistory, it is clear that the scale of the internal region must be determined by matching solutions with respect to some integral quantity that allows for the flow prehistory. Accordingly, integral matching with respect to turbulent tangential stresses at the boundary between the internal and the external regions is performed. It is shown that such matching results in a qualitatively correct description of the dynamics of interaction between internal and external regions. The theoretical findings are found to be in agreement with experiment. If the integral method is now combined with sufficiently substantiated relaxation models of turbulence, the complex problem of the analysis of inequilibrium turbulent boundary layers may be brought nearer a solution. Figures 4; references 20: 15 Russian, 5 Western.
[484-1386]

USSR

UDC 532.526.5

PHYSICAL FEATURES AND CERTAIN PROPERTIES OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL SEPARATION FLOW AT SUPERSONIC VELOCITIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 42-50 manuscript received 22 Feb 78

ZHELTOVODOV, A. A., Leningrad

[Abstract] The findings of an experimental investigation of three-dimensional turbulent boundary-layer separation in the neighborhood of skewed shock waves, wedge-shaped baffles, and sweepback baffles, at Mach numbers $M_\infty = 2, 2.25, 2.5, 3$, and 4 , and Reynolds numbers $Re_\infty = u_\infty / \nu = (30-36) \cdot 10^6 \text{ m}^{-1}$ are presented. The characteristic modes and patterns of the resultant separated flow are examined. Pressure distribution in two- and three-dimensional separated flow modes are compared and discussed and empirical formulas for determining certain of their geometrical parameters are presented. The analogy established between the characteristic pressures and pressure distributions of certain two- and three-dimensional separated flow modes points to the possibility of using certain known methods of the analysis of two-dimensional boundary layer separation for the analytic estimation of three-dimensional boundary layer separation. This conclusion is confirmed by experimental findings. Figures 5; references 19: 10 Russian, 9 Western.
[484-1386]

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THREE-DIMENSIONAL BODIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 97-102 manuscript received 2 Mar 78

GUSAROV, A. A., DVORETSKIY, V. M., IVANOV, M. YA., LEVIN, V. A. and CHERNYY, G. G., Moscow

[Abstract] The supersonic flight of bodies in the atmosphere requires the selection of their proper aerodynamic shape depending on purpose. As regards nose cones, that selection should be made with allowance for their smooth joining to the fuselage so as to minimize drag. This requirement is satisfied by surfaces formed by line segments whose one end originates at the starting section and the other, at the midsection, represented by a specified circumference. It is assumed that the length of the nose is specified and the starting section is represented by n line segments of identical length all having a common origin and extending at right angles to the incident flow. All these segments are radii of a single circle, and they divide that circle into n equal parts. On the basis of the solution of the variational problem for bodies of this kind, it is shown that they reduce drag to a much greater extent than do the optimal axisymmetric bodies. This is corroborated by a numerical investigation of the supersonic flow of an ideal gas around spatial configurations of this kind with $n = 3$. For bodies with the aspect ratio $R = 0.27$ calculations show that the drag at Mach numbers of from 2 to 6 is only 77% of the drag for the equivalent cone. Figures 5; references 11: 10 Russian, 1 Western.

[484-1386]

USSR

UDC 533.6.011.72

FEATURES OF THE DISTRIBUTION OF GAS PARAMETERS IN THE INITIAL STAGE OF
THE REBOUND OF A SHOCK WAVE FROM A SPHERE AND A CYLINDER

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKhanika ZHIDKOSTI I GAZA in Russian
No 3, 1979 pp 103-110 manuscript received 3 Mar 78

ZNAMENSKAYA, I. A., RYAZIN, A. P. and SHUGAYEV, F. V., Moscow

[Abstract] The initial stage of the reflection of curved and plane shock waves from a sphere and a cylinder as well as from spherical and cylindrical cavities is investigated in theory and experiment. Exact equations of the time derivatives of the Mach number of the reflected shock wave and of the coordinate and time derivatives of density and pressure behind the reflected shock wave along the axis of flow symmetry at time zero are obtained. In the experiments the processing of interferograms served to obtain the variation in time of the gas density behind the reflected shock waves. The experimental findings are in agreement with the theory, and thus the derived equations can be used to describe the pattern of movement of the shock wave and the variation in gas parameters along the axis of flow symmetry at least during the stage of regular reflection.

Figures 5; references 10: 9 Russian, 1 Western.

[484-1386]

USSR

UDC 533.697.4

ANALYSIS OF THE BOUNDARY LAYER IN THE NOZZLE OF HYPERSONIC CHEMICAL CW
LASERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKhanika ZHIDKOSTI I GAZA in
Russian No 3, 1979 pp 120-126 manuscript received 24 Feb 78

BASSINA, I. A., DOROT, V. L. and STRELETS, M. KH., Leningrad

[Abstract] A major element of supersonic chemical CW lasers of the diffusion type, chiefly those operating on molecules of hydrogen fluoride or deuterium fluoride, is the nozzle unit, which is represented by a system of two-dimensional or axisymmetric nozzles through which a mixture of gases containing atomic fluorine is delivered to the laser cavity. In this connection, a procedure for the analysis of a multicomponent chemically reacting boundary layer in a supersonic two-dimensional nozzle is presented with allowance for the possibility of injecting gas coolant via pores in the wall, the occurrence of heterogeneous chemical reactions at

the wall (catalytic recombination of fluorine atoms) and the reciprocal effect of the boundary layer on viscous flow. It is shown in particular that the injection of helium coolant into the porous nozzle wall reduces heat flux to the wall by nearly 25% but increases the boundary-layer thickness, which may adversely affect the power characteristics of the laser. Figures 5; references 15: 8 Russian, 7 Western.
[484-1386]

USSR

UDC 536.33+538.4

HEAT TRANSFER IN CHANNELS OF HIGH-CAPACITY MHD GENERATORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 136-149 manuscript received 31 Jan 79

BIBERMAN, L. M., ZHELEZNYAK, M. B., ZATELEPIN, V. N., LYUBIMOV, G. A., MEDIN, S. A. and MNATSAKANYAN, A. KH., Moscow

[Abstract] In the channels of high-capacity MHD generators radiant heat flux may be equal to or greater than convective heat flux. In this connection, an approximation method for calculating both radiant and convective heat transfer is presented. The calculations are based on the assumption that the temperature, pressure, and composition of the gas are uniform over the channel cross section. Allowance is made for the effect of the ionizing additive potassium, which despite its low concentration ($\sim 1\%$) markedly enhances radiant heat flux, as well as for the effect of the reflection and absorption of radiant flux by the channel walls. Further refinements in the calculations hinge on a more precise determination of the optical characteristics of the heat transfer agent and the channel walls over a broader spectral region and a broader range of pressures. To this end, it is also necessary to derive formulas for the local divergence of radiant flux and to elucidate the effect of radiant heat transfer on convective heat transfer. In view of the substantial radiant heat transfer in the channels of high-capacity MHD generators, corresponding revisions have yet to be performed as regards the design, materials, and operating modes of MHD equipment. Figures 9; references 23: 15 Russian, 8 Western.
[484-1386]

WAVEGUIDE PROPERTIES OF AN UNDERWATER MOUNTAIN RANGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 152-155 manuscript received 18 Apr 78

BABICH, V. M. and BILYY, I. YA., Leningrad

[Abstract] Submerged ridges may serve as waveguides for sea-surface waves. A simplified theory of this effect is now presented on the basis of a previous study of unsteady waves above an undersea rise, on the one hand, and of the theory of relatively inhomogeneous waveguides, on the other, so as to reduce the corresponding calculations to the solution of one-dimensional problems. A mathematical description of the propagation of the pertinent wave trains is presented within the framework of the theory of space-time geometrical optics. A readily integrable ordinary differential transport equation along a space-time ray is derived, along with a dispersion formula, and it is shown that the derivation can be shortened with the aid of Whitham's variational principle, on the premise that an underwater ridge represents a zone of lower wave velocities and, since the waveguide properties of such zones are well-known, wave trains relating to waves traveling along the underwater ridge can be described. Figure 1; references 9: 8 Russian, 1 Western.
[484-1386]

ON THE POSSIBILITY OF INJECTING A GAS JET INTO A SUPERSONIC FLOW WITHOUT FORMING A THREE-DIMENSIONAL BOUNDARY LAYER SEPARATION ZONE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 162-165 manuscript received 12 Dec 77

MASYAKIN, N. YE. and POLYANSKIY, M. N., Moscow

[Abstract] The investigation deals with the flow generated by the interaction of a supersonic current with a sonic or supersonic cross-current jet injected at right angles into the principal current by means of a nozzle with a flat-wall outlet. The purpose is to determine the nozzle outlet shape at which the three-dimensional boundary layer separation (TDBLS) zone is absent. The experiments were performed in the presence of incident-flow Mach numbers $M_\infty = 2.1-3.7$ and at Re numbers of from $2 \cdot 10^6$ to $2 \cdot 10^7$, which corresponded to a turbulent mode of flow in the boundary layer. It was established that the TDBLS zone may not occur

if the injection of the gas jet is so organized that the pressure increase ahead of the jet corresponds to the pressure increase associated with flow around a wedge with an angle of $< 12^\circ$. This is accomplished if the shape of the nozzle outlet is triangular rather than circular, since the triangular shape averts the formation of the shock wave resulting in boundary-layer separation. Figures 5; references 3 (Russian). [484-1386]

USSR

UDC 533.6.011.55+539.3

BUCKLING OF SHELLS EXPOSED TO SUPERSONIC GAS FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 3, 1979 pp 165-168 manuscript received 16 Jan 78

BELYAYEV, N. M. and KHRUSHCH, V. K., Dnepropetrovsk

[Abstract] The effect of static deformation of thin wedge- and cone-shaped shells on aerodynamic drag during supersonic flight is investigated, with the object of determining the extra wave drag of the deformed wedge or cone surface as a function of shell thickness and fuselage diameter. The associated problem of aeroelasticity, in which the shape of the deformed surface is determined in the course of a numerical solution of unsimplified equations of gas dynamics, is solved. The tabulated findings indicate that the deformation of shells in such cases may markedly increase drag. For example, during the flight of an aircraft at altitude $H = 10$ km and speed $M_\infty = 4$ the drag of a buckled conical section may be 30% greater than normal. These findings point to the necessity of additional reinforcement of shells. Figures 2; references 6 (Russian). [484-1386]

USSR

UDC 532.51.031

JET FLOW AROUND A SMOOTH CONTOUR

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 28-38 manuscript received 3 May 78

KHANIN, V. M., Institute of Thermal Physics, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] The author considers potential flow of a planar jet of imponderable fluid around a smooth convex contour. The analysis is based on an integral equation for a "smoothed" modulus of velocity on the contour. It is proved that the solution of the initial problem exists, and

that it is unique (with certain limitations). Flow around a circle is analytically considered in two asymptotic cases: for small impact parameters b , and for b close to the limiting value. Assuming "smooth" separation, it is proved that the limiting asymmetric case of flow is external tangency of the contour with the initial image of the jet, i.e. with the strip that represents the jet before it has interacted with the contour. The problem is studied numerically in the intermediate range of values of b . The author thanks M. A. Gol'dshtik for discussing the work. Figure 1; references 7 (Russian).
[403-6610]

USSR

UDC 532.594

NORMAL OSCILLATIONS OF A ROTATING LIQUID DROP

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 78-87 manuscript received 19 Jun 78

RADYAKIN, N. K., Khar'kov

[Abstract] The author considers the problem of determining the frequencies and modes of surface waves of a liquid globe uniformly rotating at constant angular velocity under conditions of weightlessness. Small free oscillations of the globe about its equilibrium shape are analyzed. The Ritz method is applied to a certain quadratic functional in computer calculations of the frequency of oscillations for an ideal liquid. Formulas for the damping constant and for corrections to the frequencies of oscillations are derived by the boundary layer method for a liquid of low viscosity. The results are graphed and tabulated. The author thanks N. D. Kopachevskiy for guidance and assistance in the work. Figure 1; references 12: 10 Russian, 2 Western.
[403-6610]

USSR

UDC 533.6.011.55

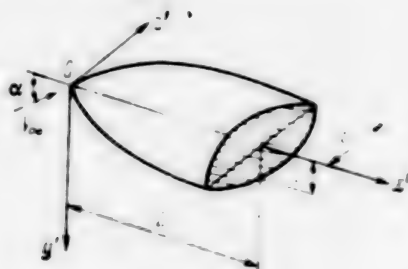
HYPERSONIC GAS FLOW AROUND A THIN WING OF VARIABLE SHAPE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 94-101 manuscript received 14 Jun 78

BOGATKO, V. I., GRIB, A. A., deceased, and KOLTON, G. A., Leningrad

[Abstract] An examination is made of the problem of uniform, homogeneous, hypersonic flow of an ideal gas around the windward side of a thin wing with time-dependent surface shape. It is assumed that the thickness,

span and chord of the wing have order $c = O(\epsilon)$, $b = O(\sqrt{\epsilon})$, $L = O(1)$ respectively (see the diagram), where ϵ is a small parameter that characterizes the ratio of gas densities on the head shock wave front. The problem is solved by the thin shock layer method. It is assumed that the head shock wave is attached to the leading edge of the wing in at least one point. First-approximation corrections are found for fundamental "Newtonian" flow. For finite aspect wings where the head shock wave is attached along the entire length of the leading edge, engineering formulas are derived for determining the gas parameters in the shock layer. Figure 1, references 6: 5 Russian, 1 Western. [403-6610]



USSR

UDC 533.6.011.6:538.6:534

INFLUENCE OF MAGNETIC FIELD ON THE THERMOACOUSTIC STABILITY OF THE HIGH-TEMPERATURE HEAT-RELEASING GAS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 102-107 manuscript received 19 Jun 78

ARTAMONOV, K. I., VOROB'YEV, A. P. and LOMONOSOV, M. M., Moscow

[Abstract] The authors determine conditions of thermoacoustic stability of a high-temperature electrically conductive gas with internal heat release located in a constant magnetic field that transforms acoustic waves to fast and slow magnetoacoustic waveforms, as well as introducing Joule dissipation. The analysis is based on the energy balance method, and also on direct solution of equations for small perturbations in the special case of wavelengths of acoustic oscillations that are small compared with the dimensions of nonuniformities in the heat release zone. Limits of stability are found with respect to fast and slow magnetoacoustic oscillations. An investigation is made of the influence that a magnetic field has on thermoacoustic stability of a high-temperature gas in which heat release is proportional to its density. It is assumed that the gas satisfies conditions of local thermodynamic equilibrium, and that radiant heat fluxes are described in the diffusion approximation. The principal

influence of the magnetic field at relatively low strength consists in dissipation of acoustic oscillations that have a component of vibrational velocity directed across the magnetic field. Figures 2, references 5: 2 Russian, 3 Western.
[403-6610]

USSR

UDC 533.695.5

INVESTIGATION OF SUPERSONIC FLOW OF AN IDEAL GAS AROUND A FLAT CASCADE IN THE CASE OF A SUBSONIC 'NORMAL' COMPONENT IN REGIMES WITH ATTACHED SHOCK WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 108-113 manuscript received 26 May 78

BOGOD, A. B., KRAYKO, A. N. and CHERNYAK, YE. YA., Moscow

[Abstract] An examination is made of supersonic flow of an inviscid, thermally nonconductive gas around a cascade of flat, pointed vanes where the velocity vector of the oncoming flow has a subsonic component normal to the front of the cascade. The analysis is limited to non-detached flows with shock waves attached to the leading edges of the vanes, and to fairly closely spaced cascades for which the shock waves departing from the trailing edges do not enter the region in front of the cascade. In such cases, the conditions behind the cascade do not influence the flow in front. In this sense the flow in the cascade is "trapped." A method is proposed for calculating all flow fields including the wave structure at large distances from the front of the cascade for modes with attached shocks, and some results found by the proposed method are presented. The authors thank M. Ya. Ivanov for assistance in updating the program for calculating supersonic flow, G. Yu. Stepanov for useful comments, and Ye. V. Baganov and V. A. Vostretsov for assistance in formulating the research. Figures 5, references 9: 5 Russian, 4 Western.
[403-6610]

USSR

UDC 533.695.7.011.5

CALCULATION OF SUPERSONIC DETACHED FLOW IN CIRCULAR NOZZLES WITH ABRUPT EXPANSION

Moscow IZVESTIYA AKADEMII NAUK SSSR: MAKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 120-128 manuscript received 20 Jun 78

GOLISH, L. V. and DASHEVSKAYA, S. G., Moscow

[Abstract] An examination is made of the interaction of a circular supersonic jet with a turbulent layer of the near wake type formed behind an annular step on the ring of a nozzle with abrupt flaring. Flow in the viscous layer is calculated by an integral method, while the inviscid flow is calculated by a method of straight-through computation using a monotonic difference scheme of first-order accuracy. The interaction between the inviscid and turbulent flows is determined by the thickness of displacement of the viscous layer. The initial conditions for flow in the layer are determined from integral conditions of splicing to the isobaric mixing flow in the base region behind the step. The calculated interaction flows are determined as a function of the length of the nozzle ring and the back pressure jointly or independently by the boundary condition of equality of pressure on the edge of the ring to the ambient pressure, and by the special solution of the equations that passes through the singular saddle point of the throat of the wake. The authors thank M. Ya. Ivanov for consultation on using his program, and Z. A. Donskova for her assistance in formulating the research. Figures 6, references 8: 7 Russian, 1 Western.
[403-6610]

USSR

UDC 535.34:537.53

ON CALCULATING TRANSFER OF SELECTIVE RADIATION IN A NONHOMOGENEOUS PLASMA

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 129-136 manuscript received 29 Dec 78

KARASEV, A. B., KONDRANIN, T. V. and KUZ'MINSKIY, I. N., Moscow

[Abstract] An approximate method is proposed for determining the spectrally integrated characteristics of transfer of radiant energy in a plane-parallel gas layer in the state of local thermodynamic equilibrium with an arbitrary degree of isothermality, and with consideration of various mechanisms of emission and absorption of radiation. The authors thank V. A. Varnav for discussing the work. Figures 5, references 8: 7 Russian 1 Western.
[403-6610]

USSR

UDC 517.9:533.7

BEHAVIOR OF SONIC LINES IN A SHOCK LAYER BEHIND A DEPARTING SHOCK WAVE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 143-145 manuscript received 28 Sep 78

GOLOMAZOV, M. M. and ZYUZIN, A. P., Moscow

[Abstract] A numerical study is done on the formation of local supersonic zones in the subsonic region of flow between a departing shock wave and the surface of a solid in the case of supersonic three-dimensional flow around conical bodies with vertex angle of 120° at Mach numbers of 2.5-15. The blunting radius of the tip is $0.3D$, where D is the diameter of the middle cross section. Calculations are based on a numerical scheme that approximates steady-state equations of gas dynamics for different Mach numbers of the oncoming flow and angles of attack, but with a constant adiabatic exponent $\gamma = 1.4$. It is shown that local supersonic zones arise on the leeward side near the shock wave, and supersonic flow in the local zone makes a smooth transition to subsonic flow without formation of a compression shock. The authors thank G. I. Petrov for formulating the problem and for constructive criticism, and O. M. Belotserkovskiy for continued interest in the work. Figures 2, references 2 (Russian). [403-6610]

USSR

UDC 532.526.75

LAMINAR MOTION PRODUCED BY ROTATION OF A DISK OF FINITE RADIUS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 4, Jul/Aug 79 pp 151-154 manuscript received 12 May 78

SIMUNI, L. M., Leningrad

[Abstract] An examination is made of axisymmetric motion produced by rotation of a disk of finite radius on the surface of a liquid. The analysis is based on consideration of a cylindrical vessel of given radius and depth filled with a viscous incompressible liquid. On the surface of the liquid is a disk of smaller radius, the center of the disk being on the axis of the cylinder. It is assumed that the free surface of the liquid is stationary and horizontal. Both the vessel and the disk are free to rotate about the axis at different angular velocities. An examination is made of the nature of the motion that arises depending on the ratio of the angular velocities. Figures 4, references 6: 3 Russian, 3 Western. [403-6610]

INFLUENCE OF LARGE VORTICES ON THE STRUCTURE OF TURBULENT CURRENTS WITH SHEAR

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 10-20 manuscript received 28 Jul 78

ABRAMOVICH, G. N., Moscow

[Abstract] The influence of large vortices on the structure and characteristic parameters of currents is studied by analyzing the Soviet and Western literature. An approximate theory is developed to explain the effects of large vortices on pressure pulsations, profiles of pulsation velocities, the energy of turbulence and the correlation of velocities. A physical model of a flat turbulent field is constructed as the basis of the mathematical analysis. Vortices are replaced by rotating cylinders and it is assumed that the radius of each cylinder is proportional to the integral scale of turbulence. The model suggested allows determination of the values of the turbulent Strouhal, Prandtl and Schmidt numbers. The theory of the long-range action of pressure pulsations which is developed, though only a rough approximation, yields the distribution of turbulence parameters in the cross section of a jet and in the boundary layer, describes the increase in turbulence along the axis of the core of constant velocity of the jet and at the flame front in a burning jet, and explains the distance of pulsations of the velocity within the laminar sublayer and along the wall, thus opening further avenues for the study of turbulence. Figures 5, references 18: 7 Russian, 11 Western.
[485-6508]

STEADY FLOW AROUND THE LOWER SURFACE OF A PIECEWISE-PLANAR DELTA WING WITH A SUPERSONIC LEADING EDGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 80-90 manuscript received 12 Jun 78

TER-MINASYANTS, S. M., Moscow

[Abstract] A study is made of supersonic flow around a wing consisting of an arbitrary number of flat elements connected at slight angles to each other along straight lines which intersect at a single point. The free edges of the terminal elements form a broken forward edge to which a three-dimensional pressure shock is attached. The parameters of the flow differ little from the parameters of flow with slipping of a wing with the finite aperture angle, called a basic wing. The theoretical calculations are checked by numerical calculations, performed for several wings. Figures 2, references 18: 12 Russian, 6 Western.
[485-6508]

USSR

UDC 533.6.011.8+536.244

STABILITY OF HEAT EXCHANGE MODES AT THE FORWARD CRITICAL POINT ON A BODY
IN A FLOW OF A DISSOCIATING GAS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in
Russian No 5, Sep/Oct 79 pp 97-106 manuscript received 26 Jan 78

AGRANAT, V. M., BERTSUN, V. N. and GRISHIN, A. M., Tomsk

[Abstract] A study is presented of the stability of steady heat exchange modes at the forward point around which a flow of dissociating air moves by means of the method of Lyapunov functions and a method based on the use of the Meksyn method from boundary layer theory. The flow is studied around the forward critical point of a cold body of rotation with a constant surface temperature by heated dissociating air. The temperature of the incident stream at the stagnation point $T_s \gg T_w$, so that recombination reactions occur only near the surface of the body. The stability of steady heat exchange modes in the vicinity of the forward critical point is analyzed. Heat exchange modes are qualitatively analyzed using a theory of dynamic systems. The steady heat exchange mode in the vicinity of the critical point is found to be independent of the Damkeller number. The time of establishment of the steady mode is not a monotonic function of the Damkeller number for a noncatalytic surface, whereas for a catalytic surface the settling time increases monotonically with increasing Damkeller number, reaching its maximum number as this number approaches infinity. Figures 3, references 16: 13 Russian, 3 Western.
[485-6508]

USSR

UDC 533.662.6

CONSTRUCTION OF AN UNSTEADY NONLINEAR THEORY OF AN AIR SCREW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in
Russian No 5, Sep/Oct 79 pp 107-113 manuscript received 18 Jul 78

BELOTSEKOVSKIY, S. M., VASIN, V. A. and LOKTEV, B. YE., Moscow

[Abstract] The method of discrete vortices is applied to the construction of a nonlinear, unsteady theory of air screws in an incompressible medium. The method can be used to model transient modes in screw operation, as well as certain characteristic modes such as the vortex ring and air cushion. The vortex method is based on replacement of the actual load-bearing surfaces (blades of the screw) with infinitely thin surfaces, with subsequent replacement of these surfaces and the wakes which follow them by a vortex shroud. The problem is solved in a rectangular system

of coordinates rigidly fixed to the blades. The method allows determination of the unsteady distribution and overall aerodynamic characteristics, the field of velocities and the vortex structures following the screw. Examples are presented, in the form of results of calculation of the aerodynamic characteristics of a two-blade air screw, performed on a computer. Figures 5, references 8: 7 Russian, 1 Western.
[485-6508]

USSR

UDC 533.69.01

SOLUTION OF THE PROBLEM OF FLOW AROUND A WING OF FINITE SPAN IN ITS LINEAR STATE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 114-125 manuscript received 23 May 78

VOROB'YEV, N. F., Novosibirsk

[Abstract] The direct and inverse problems of wing theory are solved for a wing of finite span within the framework of linear theory. The conditions of the surface of the wing are reduced to those on the base plane, slightly deflected from the surface of the wing. The Volterra equation is used to determine the velocity and potential of the perturbed flow at a point in the area of disturbance of the slightly bent wing. The potential of the perturbed flow can be represented either in terms of the direct or the reverse problem. The solution of the direct problem corresponds to that of the reverse problem with a certain integral operator kernel. Representation of the solution of the reverse wing problem as converging integrals in the sense of the primary Cauchy value allow significant simplification of the algorithm of the variational problem of determination of a wing of minimal resistance on the basis of the linear theory. Figure 1, references 9: 8 Russian, 1 Western.
[485-6508]

USSR

UDC 533.6.011

A SONIC CIRCULAR JET IN AN OPPOSITELY DIRECTED SUPERSONIC FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 175-180 manuscript received 12 May 78

KOVAL', M. A. and SHVETS, A. I., Moscow, Khar'kov

[Abstract] Two modes of interaction are possible when a circular sonic jet exits into an oppositely directed supersonic flow: with open or closed central area of separation. Experiments were performed with

$M_\infty = 3$ for 3 sonic nozzles with different ratios of inside to outside diameter. The stagnation temperature of the jet corresponded to the stagnation temperature of the incident flow, 300°C, for which the Reynolds numbers were $2-2.5 \cdot 10^6$. Photographs of the interaction are presented, as well as diagrams showing the two possible modes of interaction. Figures 5, references 2 (Russian).
[485-6508]

USSR

UDC 533.6.011.5

EXPERIMENTAL STUDY OF UNSTEADY FLOW IN CAVITIES AROUND WHICH A SUPER-SONIC STREAM MOVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 180-183 manuscript received 28 Jun 78

ANTONOV, A. N. and SHALAYEV, S. P., Moscow

[Abstract] Data are presented on the flow pattern, nature of oscillations of the compression jump, frequency and amplitude characteristics of pressure pulsations in the cavities of cylinders of various depths, open to an incident supersonic flow and placed at zero angle of attack. The models were hollow cylinders closed at one end placed in the flow so as to produce a cup open in the direction from which the flow came, the axis of the cylinder coinciding with the velocity vector of the flow. The influence of Re and the relative depth of the cavity on the flow near and within the cylindrical cavity was studied. Figures 4, references 5 (Russian).
[485-6508]

USSR

UDC 536.24:532.526

NONUNIFORM FLOW AROUND BLUNTED BODIES IN A HYPERSONIC STREAM OF CARBON DIOXIDE GAS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 79 pp 199-202 manuscript received 18 May 78

GOLOVACHEV, YU. P., Leningrad

[Abstract] The Navier-Stokes equations are used to study a hypersonic stream of carbon dioxide gas moving around blunted bodies considering the nonequilibrium course of reactions and oscillating relaxations of CO_2

molecules. The flow region studied is limited by the axis of symmetry and a certain perpendicular located at some distance from the critical point. Results of the calculation are compared with a locally self-similar solution for the vicinity of the forward critical point found in an earlier work without separation of the departing shock wave. The primary difference in the results is in the thickness of the shock layer, explained by the inaccuracy of the one-dimensional flow model used in the earlier work. Figures 5, references 9: 6 Russian, 3 Western.
[485-6508]

USSR

UDC 621.165.032.5:532.55:001.89

FLOW STRUCTURE BEHIND PLANE TURBINE CASCADES WITH EXTRA BLADES WITHIN THE BLADE CHANNELS

Minsk IZVESTIYA VUZov: ENERGETIKA in Russian No 7, 1979 pp 108-111
manuscript received 12 Feb 79

BASHUROV, B. P., Affiliate of the Leningrad Order of Lenin Shipbuilding Institute

[Abstract] Secondary eddy currents are a major factor in adversely affecting the operating economy and hence also capacity of turbine engines. These currents can be effectively eliminated by installing extra blades inside the blade channels. However, extra blades can also produce adverse consequences by increasing friction loss in boundary layers at their surfaces, as well as by increasing edge loss and, if poorly designed, causing the heat transfer agent to flow from the concave to the convex side of the blade. In this connection, new experimental data contributing to the available statistical information needed to broaden the range of applications of extra blades are presented. The experiments were performed on a turbine nozzle with extra blades of sheet metal ($\delta = 1$ mm) installed along the median line of the blade channel. Three nozzle variants having the relative spacing $t/b = 0.42, 0.64$, and 1.0 , respectively, as well as two variants of relative height of the extra blades, $h = h/l = 0.04$ and 0.09 , were used. It was found that the effectiveness of the extra blades hinges on the geometrical characteristics of the blade channel-extra blade system and on the degree of development of secondary eddy currents. The installation of extra blades proved effective in reducing the energy loss due to secondary eddy currents in every case except when $t/b = 0.42, h = 0.09$. Figures 3; references 4 (Russian).
[498-1386]

CONCERNING THE INFLUENCE THAT HYDROPHOBIC AND HYDROPHILIC HEAT EXCHANGE SURFACES HAVE ON CRITICAL TEMPERATURE

MOSCOW IZVESTIYA VUZov: MASHINOSTROYENIYE in Russian No 10, 1979 pp 74-78
manuscript received 15 Nov 78

LEBEDEV, D. P., candidate of technical sciences, MEN'SHOV, V. N., engineer, ANDREYEV, YE. F., candidate of technical sciences, and UVAROV, V. V., candidate of technical sciences, docent

[Abstract] At low pressure, molecular flows of vapor condense out on a heat exchange surface below some critical temperature T_c . In this article, analytical relations are found for the way that pressure depends on T_c with consideration of the conditions of wettability of the condensation surface by water. It is shown that when the residual vapor pressure is higher than 113 N/m^2 , the process of desublimation is principally influenced by the state of the condensation surface, while the principal factor below 113 n/m^2 is the gasdynamic situation close to the desublimation surface. Figures 2; references 18: 14 Russian, 4 Western.
[419-6610]

HYDRAULIC HAMMER WHEN A PIPE IS BEING FILLED WITH LIQUID

MOSCOW IZVESTIYA VUZov: MASHINOSTROYENIYE in Russian No 10, 1979
pp 88-91 manuscript received 24 Feb 78

SHUL'GIN, V. V., candidate of technical sciences, docent

[Abstract] The problem of hydraulic hammer is usually treated as the oscillations that arise in fluid pressure in a system when steady-state flow is disturbed by the motion of gate valves, pump pistons and the like. In this paper the author considers the nonstandard case where hydraulic hammer arises as a system is being filled with liquid. The hammer action is caused by local constrictions in the pipes of the system. Based on a differential equation for unsteady flow, the author derives a formula for the flow velocity in the pipe at the instant when hydraulic hammer arises. It is shown that the force effect of the hammer action can be considerable when there are sudden constrictions in the pipes of the system being filled. The most dangerous configurations are those with a constriction in the initial section of the line, where the velocity of unsteady flow has its highest values. Figures 2; references 2 (Russian).
[419-6610]

THE EFFECT OF A GASEOUS MEDIUM ON FRICTION PAIRS IN THE SELECTIVE TRANSFER MODE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian No 5, 1980 pp 23-27 manuscript received 20 Nov 78

LEBEDEV, V. M. and ASHEYCHIK, A. A.

[Abstract] The effect of selective transfer for friction pairs operating in various gaseous media and a vacuum was investigated on an end friction and wear installation developed at the Leningrad Polytechnical Institute. The installation provided operating modes most frequently encountered during operation of friction subassemblies. The investigations showed that friction subassemblies in the selective transfer mode can operate in a vacuum and in inert gases. The gaseous medium in which the friction subassemblies will operate must be taken into account when designing those intended for operation in the selective transfer mode. Oxygen dissolved in the lubricants has a specific effect on the friction processes. Figures 3; references 5 (Russian).

THE FLOW OF AN UNDEREXPANDED JET BETWEEN TWO BODIES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian No 5, 1980 pp 49-52 manuscript received 1 Sep 78

KARDANOV, YU. KH.

[Abstract] The flow of a single jet in the space between a flat bottom surface of a body and a blunt obstacle with coaxial arrangement or mutual transverse displacement of them was investigated experimentally. The gas jet was assumed to be severely underexpanded. Variation of the flow pattern in the space between two bodies leads to a corresponding variation of the wave structure of flow and of the force effect of the jet on both bodies. The pressure distribution along the surface of the obstacle differs from the pattern typical for uniform flow around a blunt body. The main difference is that the maximum pressure occurs during axisymmetrical flow on the section of surface located in the region of the jet with the highest velocity head rather than at the tip of the body. The peak pressure on the bottom surface disappears upon transition to flow with an open base region. The pressure distribution along the surface of the

obstacle acquires the typical form for uniform flow. Asymmetrical flow around separate bodies during mutual transverse or angular displacement of them leads to significantly nonuniform pressure distribution along the surface of the bodies. Figures 2; references 3 (Russian).

USSR

UDC 532.516:621.822.5

THEORY OF THE HYDRODYNAMIC LUBRICATION OF A LOADED BEARING

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979
pp 66-70 manuscript received 23 Apr 79

AREF'YEV, B. A. and TALAYKOVA, N. B., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Theoretical research into the lubrication of bearings often conflicts with experimental findings, and it is assumed that the Reynolds equation, which underlies all theoretical calculations, does not apply in the region of negative pressures of the lubricant film, which becomes discontinuous after passage across a minimal clearance. In this connection, proceeding from the premise that pressure distribution and loading capacity should be considered together, rather than separately as has been done previously, formulas for determining the coordinates of the point of onset of lubricant-film discontinuity are derived as functions of the load and pressure distribution on the surface of the fixed part of the bearing. The formulas are based on the assumption that the lubricant film is continuous only where the pressure $p \geq 0$, while in the other areas of bearing surfaces, owing to physical features of the lubricant (where the lubricant releases bubbles of dissolved air) the continuity is broken and the excess pressure is zero. Figures 2; references 9: 5 Russian, 4 Western.
[12-1386]

USSR

UDC 534.232

STABLE RADIAL OSCILLATIONS OF A PIEZOCERAMIC SPHERE IN A COMPRESSIBLE FLUID

Kiev PRIKLADNAYA MEKhanika in Russian Vol 15 No 10, Oct 79 pp 45-49
manuscript received 26 Jul 78

BORISYUK, A. I., and KIRICHOK, I. F., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] Steady forced radial oscillations of a piezoceramic spherical shell immersed in an infinite liquid medium, with its internal cavity filled with a compressible liquid of a different density from that of the

medium, are studied. The inner and outer surfaces of the shell are completely covered with electrodes, to which a variable potential difference is applied, exciting the oscillations. Analysis of the results of the mathematical study shows that filling the internal volume of the sphere with a liquid has a varying effect on the characteristics of oscillation of thin and thick shells. The first resonant frequency of a thick liquid-filled shell is approximately 2% lower than the corresponding frequency of an unfilled sphere, whereas for a thin shell it is almost 25% higher. In the frequency band studied, the unfilled shell has one resonant frequency, whereas the filled shell has three. Figures 2; references 9: 8 Russian, 1 Western.
[488-6508]

USSR

UDC 536.01.46

SELF-SIMILAR BURN WAVES IN THE PRESENCE OF NONLINEAR HEAT CONDUCTIVITY

Moscow VESTNIK MOSK. UNIVERSITETA, SERIYA 1, MATEM. MEKH. in Russian
No 5, 1979 pp 70-74 manuscript received 29 Mar 78

LEYBENZON, A. S., Moscow, Chair of Hydromechanics, Moscow University

[Abstract] The propagation of a self-sustained wave of combustion in a medium with nonlinear heat conductivity is analyzed. The medium is represented by an ideal gas (fully ionized plasma) with an adiabatic exponent of $5/3$. Bremsstrahlung loss is not taken into account, but allowance is made for heat conductivity and exothermic reactions such as may arise at high temperatures (several keV). Self-similarity conditions are derived and a numerical solution is constructed for the $D + T$ reaction. The extremal case in which the motion of the medium can be disregarded is considered. An asymptotic solution for the neighborhood of the wave front is obtained. Figures 3; references 10: 5 Russian, 5 Western.
[495-1386]

USSR

UDC 621.384.64+621.384.658

ACCELERATORS FOR INDUSTRY AND MEDICINE (CURRENT STATUS AND OUTLOOK)

Moscow ATOMNAYA ENERGIYA in Russian Vol 47 No 4, 1979 pp 225-230

GLUKHIKH, V. A., Director, Scientific Research Institute of Electrophysical Apparatus imeni D. V. Yefremov, Leningrad

[Journal version of a paper delivered at the Third All-Union Conference on the Use of Charged Particle Accelerators in the National Economy held in Leningrad in June 1979]

[Abstract] A brief survey of the present uses of accelerators in industry and medicine, and prospects for future applications. In the last 3-4 years the installed power of industrial radiation facilities using accelerators has doubled. Among promising uses in the field of environmental protection is radiation treatment of waste water and exhaust gases produced in heavy industry and electric energy generation. Research on increasing power and improving reliability has brought a cw power of 1 MW or more within the range of industrial radiation treatment facilities. However, more research is needed to make such power levels practically feasible. Another promising area is direct utilization of activation analysis of ores before extraction from the ore body. Waveguide linacs are now being used for flaw detection on steel items up to 350 mm thick. These radiographic facilities could be improved by eliminating the need for developing x-ray plates. Electron accelerators are now widely used in radiation therapy, and research is in progress on the application of proton beams in this field. This work will be expedited by the design of medical facilities as replacements for the proton accelerators now being used that are intended for physics experiments. Another application for proton accelerators is the creation of short-lived protons for diagnosing illnesses. Figures 10; references 29: 22 Russian, 7 Western. [1861/455]

ON THE FEASIBILITY OF ENERGY LEVEL POPULATION INVERSION BY HETEROGENEOUS MIXING OF CHEMICALLY REACTING FLOWS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248 No 5, 1979 pp 1093-1096 manuscript received 23 Jul 79

ALFEROV, V. I., BIRYUKOV, A. S., DMITRIYEV, L. M., MARKACHEV, YU. YE., MARCHENKO, V. M. and PROKHOROV, A. M., academician, Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] An analysis is made of the possibility of achieving non-equilibrium states in cw lasers by heterogeneous mixing of chemically reacting reagents where one of the components is in a gas flow, and the other is injected into the flow as a stream of aerosol particles. Mixing is achieved as the particles are vaporized by aerodynamic heating. The chemical reaction takes place in the aerodynamic wake of the particle. Nonequilibrium states of the molecules arise with simultaneous occurrence of reactions, relaxation processes, convective and diffusion cooling in the mixture. A model is proposed that describes the onset and "quenching" of nonequilibrium states in the flow with heterogeneous mixing with consideration of gasdynamic and chemical interaction of the aerosol particle with the flow, relaxation kinetics, and the convective and diffusion cooling of the reaction products taking place in the far wake, and also the collective interaction of the particles (aerodynamic wakes) with the flow. The model is applied to analysis of the interaction of a flow of $\text{He}+\text{O}_2$ heated in a precombustion chamber to 3000 K and cooled with adiabatic expansion in a nozzle to 300 K, and an aerosol jet of CS_2 . The chemical reactions generate vibrationally excited CO molecules. The results of the analysis demonstrate the practical feasibility of the proposed arrangement. Heterogeneous mixing lasers allow a wide variety of initial agents, interaction schemes, use of structural properties of the particles such as porosity for transfer of chemical components, and catalytic activity. Figures 4; references 13: 9 Russian, 4 Western. [61-6610]

DEVICE FOR INTERPRETATION OF AERIAL COLOR PHOTOGRAPHS

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979 pp 91-95 manuscript received 5 Jan 79

GERBYLEV, V. S. and UZILEVSKIY, V. A., Leningrad Electrotechnical Institute imeni M. A. Bonch-Bruyevich

[Abstract] The device was developed for interpreting spectrozonal aerial color photographs of forest tracts with the object of determining such features as tree species, tree height, and mean treetop diameter, among

others. A block diagram of the device is presented: its operating principle is based on spectrozonal color separation, and it includes a viewscreen with 14x magnification of photograph sections. The pattern recognition unit included in the device compares the actual affected cell numbers with the cell numbers of 1-th class stored in the device's memory. If the numbers coincide, signals proceed to the determinants of quantitative characteristics. The device can simultaneously classify two or more classes of features. Comparison of the findings of such an automatic interpreter with actual on-ground measurements demonstrates its high accuracy. Figures 4; references 6 (Russian).
[12-1386]

USSR

UDC 535.417+621.373:535

COHERENT GAUSSIAN BEAM INTERFERENCE IN LASER-TYPE DOPPLER FLOW RATE METERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 752-758
manuscript received 4 Jan 79

SKVORTSOV, V. V.

[Abstract] In laser-type Doppler (gas and fluid) flow rate meters (LDFRM) with a differential optical scheme the information on flow rate is extracted from the signal generated by the transit of light-scattering aerosol particles across the interference field formed in the zone of the intersection of coherent laser beams having a Gaussian light intensity distribution. In this connection, analytic formulas for the characteristics of the interference field of LDFRM are derived for the case in which the laser rays are incident on the shaping lens of LDFRM with a differential optical scheme that is skewed relative to the lens axis. The formulas are derived within the framework of the paraxial approximation. In particular, the spacing of the interference bands in relation to the field coordinates is analyzed and it is shown that this relationship is either represented by a symmetrical parabola or by a near-linear dependence. Figures 5; references 9: 5 Russian, 4 Western.
[1-1386]

INVESTIGATION OF AN ACOUSTOOPTICAL MODULATOR USING COUPLED PLANE WAVEGUIDES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 772-775
manuscript received 9 Oct 78

GUDZENKO, A. I., DERYUGIN, L. N., OSADCHEV, L. A., MARKOV, V. A.,
SINTYURIN, G. A. and TISHCHENKO, A. A.

[Abstract] Integral optical data processing systems require high-speed elements for controlling the parameters of the optical waveguide wave (OWW) and particularly for controlling its amplitude. In this connection research into devices whose operating principle is based on the interaction between OWW and acoustic three-dimensional waves (ATW) is highly promising. Since, however, the effectiveness of the interaction between AWW and ATW amounts to only a few percent, an amplitude modulator based on coupled plane waveguides and serving to markedly enhance that effectiveness is now investigated. A diagram of this modulator is presented and described. A high-frequency signal with meander modulation was experimentally supplied to the electrodes of a quartz crystal transducer joined with epoxy resin to the optical-waveguide substrate. The optical emission of the system proceeded to an FEU-77 photomultiplier and thence via a 1 MHz band amplifier, to an oscillograph. These experiments point to the fundamental feasibility of 100% modulation of AWW with frequencies equal to the fundamental as well as doubled frequencies of acoustic waves, in optical waveguides made of both crystal and isotropic and amorphous materials. Figures 4; references 2: 1 Russian, 1 Western.
[1-1386]

ANALYSIS OF ASYMMETRICAL MIRRORS WITH A THIN ABSORBING FILM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 776-779
manuscript received 9 Oct 79

GOLDINA, N. D.

[Abstract] "Asymmetrical mirrors" here refer to multi-layered coatings whose reflection coefficients differ at incidence of light from both sides (R_1 and R_2). The adsorption coefficients $A_1 = 1 - R_1 - T$ and $A_2 = 1 - R_2 - T$ also differ, so that the system is considered reciprocal, i.e. the transmission coefficients in the opposite directions are identical ($T_1 = T_2 = T$). In such mirrors the structure of the coating should include absorbing films. A metal film on a substrate represents an

elementary example of the asymmetrical mirror. The paper deals with a case in which a thin metal film--of a thickness much smaller than the wavelength of the incident light--is a necessary component of a dielectric multi-layered coating. The structure is considered. It is shown that the problem of the synthesis of an asymmetrical mirror with different reflection and absorption coefficients on the front and obverse sides reduces to the simpler problem of the synthesis of a dielectric multi-layered mirror with a specified amplitude and phase at reflection. The thin absorbing film is in this connection characterized by a lumped complex admittance. Figure 1; references 7 (Russian). [1-1386]

USSR

UDC 621.373:535+535.513

SPATIAL RADIATION COHERENCE OF A NEODYMIUM DOPED GLASS LASER AND OF ITS SECOND HARMONIC

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 780-787
manuscript received 23 Dec 78

DUKHOVNYY, A. M., KOROLEV, A. YE. and STASEL'KO, D. I.

[Abstract] The relationship between the spatial coherence (SC) of harmonic radiation with the SC of fundamental radiation in the presence of sufficiently high values of SC over the laser beam cross section ($\rho \geq 0.5$) is investigated, since this case is of the greatest interest from the standpoint of the utilization of radiation frequency multipliers in holography. The experiments were conducted with a Nd-doped glass monopulse laser (lasing pulse duration ~ 30 ns spectrum width $< 10^{-3}$ nm). The second harmonic of laser radiation was excited in a 35 mm long KDP crystal. The spatial coherence functions of the fundamental radiation and of the harmonic were measured by a holographic method, and the conditions under which the SC of radiation of the harmonic decreases or increases compared with the fundamental radiation were determined. A theoretical analysis of the process of the conversion of radiation to the harmonic, accompanied by a decrease in the SC of the harmonic compared with that of the fundamental radiation, is performed, and its conclusions are found to be in agreement with the experimental findings. Figures 5; references 9 (Russian). [1-1386]

DIFFRACTION OF GAUSSIAN LIGHT BEAMS ON ACOUSTIC WAVES (OBLIQUE INCIDENCE)

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 796-798
manuscript received 5 Jan 79

GLINSKIY, A. A.

[Abstract] The diffraction of Gaussian light beams on an acoustic plane wave is investigated for the case of oblique incidence of the beam. For this case an additional coordinate system is introduced, and a formula for the electrical field of the primary light wave E_0 is presented. Upon proper substitution, a formula for computing E_1 in the form of a triple integral is then derived. It is shown that, unlike in the case of normal incidence of the Gaussian light beam, the integral cannot be reduced to a single integral, and hence the calculation of E_1 can be only numerical. The findings of an investigation of the $|E_1|^2$ field, as restricted to the xoz-plane in which the highest diffraction peaks are observed, are presented. References 4 (Russian).
[1-1386]

TEMPERATURE DEPENDENCE OF THE LINEAR ELECTRO-OPTICAL PROPERTIES OF CERTAIN SPHALERITE-STRUCTURE CRYSTALS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 798-800
manuscript received 15 Jan 79

OKROASHVILI, T. G.

[Abstract] Among the unsolved problems of the theory of the linear electro-optical effect the investigation of temperature effects in non-centrosymmetric crystals is of major interest. In this connection such effects were experimentally investigated in elementary biatomic sphalerite-structure single crystals of GaAs, CdTe, ZnS, ZnSe, and CuI, placed in a nitrogen cryostat, with the measurements being performed in circularly polarized radiation of a He-Ne laser ($\lambda = 633 \text{ nm}$) within the 100-300 K temperature range. The temperature coefficients were found to lie within the 10^{-3} deg^{-1} range. These coefficients were compared with the coefficients of the temperature dependence of the refractive index (n) and the width of the forbidden band E_g , and were found to exceed them by more than one order of magnitude. This fact warrants the conclusion that the

temperature dependences of the linear electro-optical effect are of a fundamentally different nature than that underlying the change in n and E_g . Further research over a broader range of temperatures is needed to understand the physical nature of the specific aspects of temperature effects in electro-optics. References 3: 2 Russian, 1 Western.
[1-1386]

USSR

UDC 621.373:535

CONDITIONS OF SELF-EXCITATION OF MOVING STRIATIONS IN GAS LASERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 800-803
manuscript received 1 Feb 79

FOFANOV, YA. A.

[Abstract] The optimization of the parameters of gas laser radiation often requires minimization of the level of fluctuations in the positive gas discharge column (PC), and one of the most characteristic and least investigated types of these fluctuations is moving striations (MS). As shown by previous experiments, the MS arriving at the anode modulate the discharge current. In this connection, formulas for the amplitude and wave number (frequency) of MS in steady single-frequency mode are derived. A phenomenological electrical model of the process of the self-excitation of MS, represented by a series-connected electrical circuit with a non-linear active element, is constructed without ascribing the perturbations in the PC to any specific physical factor. The relationship between the perturbations in the PC and the modulation of current in the external circuit is described by the phenomenological coefficients α, β, γ . The introduction of these coefficients serves in this case to markedly bypass the complex question of boundary conditions. Within the framework of this model it is possible to explain the experimental findings showing that the amplitude of MS becomes zero upon activation of the external feedback: the activation results in an equivalent change in load resistance. Figures 2; references 8: 5 Russian, 3 Western.
[1-1386]

DISPLACEMENT AND SPLITTING OF THE ENERGY LEVELS OF F-CENTERS IN THE O^- FIELD OF THE CRYSTALS OF ALKALI METAL CHLORIDES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 806-808
manuscript received 19 Feb 79

SALOMATOV, V. N. and PARFIANOVICH, I. A.

[Abstract] The first theoretical estimates of the variation in the energy parameters of F-centers in the O^- field are presented. The calculations were performed within the framework of the theory of perturbations, and they pertained the variation in the position of the energy levels of the F-center in the field of the O^- ion, located at distances of $a\sqrt{2}$ (a is the nearest inter-ion distance) from the F-center in alkali metal chlorides. It is shown that a perturbation conditioned by the O^- impurity ion causes the 1s- and 2p-levels of the F-centers to approach the conduction band and that, when $R = a\sqrt{2}$ (where R is the distance between the F- and O^- -centers), mixing of the upper split 2p-level with the conduction band is possible. A comparison of these findings with experiment could contribute to determining the distance between the interacting F- and O^- -centers and estimating the spatial form of the relaxed excited state (RES) of the F-center, considering that the presented calculations show that in the O^- field the energy characteristics of RES vary less than do the characteristics of the fundamental and non-relaxed excited states. References 19: 5 Russian, 14 Western.
[1-1386]

ELECTRON-IMPACT EXCITATION OF STATES IN A DOUBLY CHARGED CESIUM ION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 4, 1979 pp 808-810
manuscript received 26 Feb 79

SMIRNOV, YU. M. and SHAPOCHKIN, M. B.

[Abstract] The electron-impact excitation of 9 transitions of a doubly charged cesium ion, lying within the 2400-2900 Å range, was investigated. All findings were obtained by the intersecting beam method. The electron beam was shaped by means of a four-electrode electron gun and its density was modulated by supplying positive square voltage pulses. The resultant values of transition wavelength, position of the excitation function threshold, position of the maximum, and absolute transition excitation

cross section, were tabulated. All the investigated transitions were among the strongest within the (vacuum ultraviolet) spectral range considered. For two of the investigated transitions it was possible to determine the upper and lower level positions. All the excitation functions have a maximum within the energy range 2.2-2.6 E threshold. Despite the complexity of the investigated process (double ionization with simultaneous excitation of the third electron), the transition excitation cross sections were comparatively large, $\sim 10^{-18}$ cm². A diagram of a typical excitation function is presented. Figures 1; references 4: 3 Russian, 1 Western. [1-1386]

USSR

UDC 621.391.83

ESTIMATING THE DYNAMIC SPATIAL FREQUENCY-CONTRAST CHARACTERISTIC OF A PULSE-TYPE IMAGE CONVERTER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 3-4 manuscript received 4 Oct 78

DASHEVSKIY, B. YE.

[Abstract] An image converter is considered in the most favorable operating mode, namely with a light signal impinging on the receiver photocathode only at the peak of the voltage pulse which opens the shutter. In order to estimate the effect of inevitable instability of the pulse peak, regardless of the pulse duration, it is necessary to determine the dynamic spatial frequency-contrast characteristic of the device. This is done by multiplying its static characteristic by the factor $\frac{\sin \pi NR}{\pi NR}$, where N denotes the spatial frequency and R denotes the image displacement. Calculations indicate that the dynamic characteristic and thus the overall performance of a pulse-type image converter can be improved by using luminophors with a long flareup time. Figures 2; references 4: 2 Russian, 2 Western. [7-2415]

A FAST-RESPONSE FILM PHOTODETECTOR OPERATING ON THE BASIS OF PHOTON DRAG OF CHARGE CARRIERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 58-59 manuscript received 1 Nov 78

KURBATOV, L. N., TRUKHIN, V. N. and SHAKHIDZHANOV, S. S.

[Abstract] A laboratory prototype of fast-response film photoreceivers has been produced on the basis of a study concerning the photon drag effect in bismuth films. These films, 2000-3500 Å thick, were deposited on Si and GaAs substrates by the thermal condensation method. They were tested in normally and obliquely incident light from a CO₂ laser with frequency tuning over the $\lambda = 9.5-10.6$ μm range of wavelengths, emitting 120 ns pulses and operating in the mode locking mode. Obliquely incident light was found to generate a fast emf with distinct drag characteristics: linearly dependent on the laser power, accurately duplicating the form of the laser pulse, and reversing the polarity only upon reversal of the incidence angle of the laser beam. The time resolution of this photoreceiver could be checked only down to $2 \cdot 10^{-9}$ s. Figures 2; tables 1; references 5 (Russian).

[7-2415]

OPTIMIZING THE TRANSMISSION COEFFICIENTS OF MIRRORS IN MENISCUS-COLLIMATOR VIEWFINDERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 59-60 manuscript received 30 May 78

SENATOROV, V. N. and POLEZHAYEV, V. V.

[Abstract] A meniscus-collimator viewfinder offers the advantages of achromatism and compatibility of its focal surface with the convex screen of a cathode-ray tube, but it requires two light splitters along the viewing line: one at the meniscus and one of the plane mirror. For operation together with a constant-brightness background simulator, it therefore is necessary to optimize the ratio of reflection coefficient to transmission coefficient in the marker-grid viewing channel and in the background tracking channel so as to attain the required contrast on the marker-grid. This is achieved by maximizing the respective transmission coefficients, the feasibility being demonstrated here theoretically on

the basis of relations which disregard losses in the glass and in the light splitting layers, also practically with the use of a complementary mirror meniscus adjustable for superposition of the two marker-grid images formed by both other mirrors. Figures 3; references 4 (Russian).
[7-2415]

USSR

UDC 531.1

INDUCED OSCILLATIONS OF NONCONSERVATIVE ELASTIC SYSTEMS WITH TRANSITION THROUGH RESONANCE

Kiev DOPOVIDI AN UKR SSR, SERIYA A, FIZ.-MAT. TA TEKHN. NAUKY in Ukrainian
No 8, 1979 pp 630-635 manuscript received 4 Sep 78

ZAHORODNYA, N. V. and KOVAL'CHUK, P. S., Kiev State University and the
Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] Unsteady-state processes occurring in nonlinear oscillatory systems in the presence of external disturbances with time-dependent parameters were investigated with respect to nonconservative elastic systems whose nonconservative properties are due to the action of positional forces dependent on the position of the system. Attention was focused on the transition of such systems through fundamental resonance. In addition, steady-state resonance vibrations are investigated on the basis of first-approximation equations derived by the Mitropol'skiy method. Aspects of the resonance transition of a system with two degrees of freedom are examined by means of analog simulation. Figures 4; references 5 (Russian).
[482-1386]

USSR

UDC 539.3

APPLICATION OF THE INVARIANT SUBMERSION METHOD TO THE SOLUTION OF THE AXISYMMETRICAL PROBLEM OF ELASTICITY THEORY

Kiev DOPOVIDI AN UKR SSR, SERIYA A, FIZ.-MAT. TA TEKHN. NAUKY in Ukrainian
No 8, 1979 pp 640-643 manuscript received 16 Nov 78

VIKITIN, S. K., Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] The solution of the axisymmetrical problem of elasticity theory by an invariant submersion method is examined. The invariant submersion method of solving boundary-value problems differs from other methods in that the length of the domain or range is varied. The use of this method makes it possible to construct a single-step algorithm for the solution of a two-point boundary-value problem by reformulating it as a Cauchy problem. Such an approach serves to reduce computer time and memory volume compared with other numerical methods. The theoretical findings are found to be in agreement with test calculations for a hollow cylinder under uniformly distributed pressure, as well as for the stress-strain state of a hollow cone of varying thickness for which the solution of the problem takes up just one minute of computer time without requiring the use of external storage. Figures 2; references 3 (Russian).
[482-1386]

STABILITY OF A TRANSVERSALLY ISOTROPIC SPHERICAL SHELL

Kiev DOPOVIDI AN UKR SSR, SERIYA, A, FIZ.-MAT. TA TEKH. NAUKY in Ukrainian No 10, 1979 pp 805-808 manuscript received 5 May 79

BABYCH, I. YU. and DERYHLAZOV, L. V., Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] The stability of a spherical shell having thickness $2h$ and median surface radius R , subjected to uniformly distributed external pressure \bar{q} , is investigated from the standpoint of the three-dimensional linearized theory. The minimal values of the critical pressure q at which the shell loses its stability are derived from the condition of existence of nontrivial solutions of the corresponding system of equations. The findings make it possible to estimate as well as to determine the limits of applicability of various simplified approaches to research into the stability of isotropic and anisotropic spherical shells. Figures 4 (Russian).
[481-1386]

VIBRATIONAL STABILIZATION OF THE DYNAMIC EQUILIBRIUM AND THE MIXING PROCESSES IN GAS-LIQUID SYSTEMS

Kiev DOPOVIDI AN UKR SSR, SERIYA A, FIZ.-MAT. TA TEKH. NAUKY in Ukrainian No 10, 1979 pp 809-813 manuscript received 22 Dec 78

HANIYEV, R. F. and TSAPENKO, A. S., Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] The experimentally established resonance effects of vibrational stability of bubble swarms and periodic gas-liquid structures in a gravitational field of forces are theoretically substantiated. In addition, proceeding from the analysis of the possible forms of the vibrational movement of gaseous inclusions, the mixing mechanisms accompanying the formation of dynamically stable nonlinear "liquid-gas" oscillatory systems are discussed. One such mechanism is the existence of a dynamic mode of periodic variation in the volume of large gas cavities owing to merging and separation of the bubbles. The movement of bubbles in various directions may also be due to the complex and time-dependent shapes of the cavities. Together, these mechanisms account for the random

pattern of movement of gaseous inclusions and hence also for mixing processes in gas-liquid systems. The resonance nature of the vibrational stability of large gas cavities in itself points to the possible mechanisms of the mixing process in strong and weak gravitational fields. Figures 3; references 4 (Russian).
[481-1386]

USSR

UDC 539.3

SCATTERING OF A PLANE HARMONIC LONGITUDINAL WAVE ON SOLIDS OF REVOLUTION

Kiev DOPOVIDI AN UKR SSR, SERIYA A, FIZ.-MAT. TA TEKN. NAUKY in Russian No 11, 1979 pp 924-927 manuscript received 30 Jan 79

PODIL'CHUK, YU. M. and STARYKOV, V. A., Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] Approximate solutions of axisymmetrical problems of the scattering of a plane harmonic longitudinal wave on near-spherical solids of revolution (absolutely rigid mobile inclusions and cavities) are constructed. This is accomplished with the aid of an exact solution of the external dynamic problem for a sphere. The solution of the original problem is reduced to the solution of infinite systems of linear algebraic equations. The stress-strain condition of the medium containing the inclusions is investigated on determining the potentials of the reflected waves. References 5: 4 Russian, 1 Western.
[496-1386]

USSR

UDC 621.181.8-462:539.4.004

CAUSES OF FLEXURAL STRESSES IN UNHEATED TUBE SEGMENTS OF CONVECTIVE STEAM GENERATING BOILERS IN 300 MW POWER UNITS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 12, Dec 79 pp 53-54

HEISFRIED, E. I., engineer, and KORMAN, A. I., candidate in technical sciences, All-Union Institute of Heat Engineering imeni F. E. Dzerzhinskiy

[Abstract] Flexural stresses in angle welds and in butt welds along tubing coils of convective steam generating boilers are a major cause of damage to heat exchange surfaces. The tubing is made of austenitic or pearlitic steel (12Kh18N12T, 12KhMFSR, 12Kh1MF), the welds are not subject to severe heating in service. A study was made to determine the causes

of these flexural stresses, since they result in up to 60% of all damages. The study included boilers of 300 MW power units: eight PK-11 boilers in two electric power plants, four P-50 boilers in one electric power plant, eight TPP-210A boilers in two electric power plants, and twelve TGMP-114 boilers in four electric power plants. An analysis has revealed flexural stresses of 20 kgf/mm^2 on the average but reaching 50 kgf/mm^2 in angle welds, as high or much lower ones in butt welds depending on the mode of tube fastening and support. The cause of such stresses could be traced to rigid fastening and support on beams, or to sliding from suspension hooks. Figures 3; references 3 (Russian). [8-2415]

USSR

UDC 621.67.001.5

STRENGTH OF MULTI-MASS ROTORS WITH SLOTTED GASKETS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 6, Jun 79 pp 7-9

SIMONOVSKIY, V. I., candidate in technical sciences: and SHEVCHENKO, V. A., engineer

[Abstract] The hydrodynamic forces arising in the slotted gaskets of rotors of centrifugal machinery (pumps, high pressure compressors) contain circular components which cause the rotor systems to lose strengths. Single-mass rotor models with slotted gaskets become unstable when their angular velocity equals twice the critical frequency; multi-mass multi-slot rotor systems have not been investigated. Analysis of these systems is almost impossible because of the high order of the characteristic equation and extremely unwieldy expressions of its coefficients as functions of system parameters; even numerical computations performed by computer are complicated. In the final analysis, it reduces to finding a value of the unknown (ω) at which $\alpha = 0$. If the rotor of a centrifugal pump is designed flexible, placement of its working rate of rotation between the first and second critical velocities will reliably ensure its strength. The spacing of interpolation determines the accuracy of calculation. Figures 2; tables 1; references 6 (Russian). [413-8617]

USSR

UDC 621.165.0015

EFFECT OF OPEN AXIAL CLEARANCE ON AXIAL STRESS IN TURBINE COMPARTMENT

Minsk IZVESTIYA VUZov: ENERGETIKA in Russian No 7, 1979 pp 103-105
manuscript received 6 Feb 79

D'YAKONOV, R. I. (deceased), DROKONOV, A. M., AFANAS'YEV, R. D., and
SIVAYEV, V. M., Bryansk Institute of Transport Machine Building

[Abstract] The current increase in turbine unit capacity poses tighter requirements on reliability of performance and particularly on the accuracy of calculation of the axial stress acting on the turbine thrust bearing. In this connection, the findings of an experimental investigation of the axial stress acting on the turbine-stage blading and runner as a function of the open axial clearance at the blade roots are presented. It is shown that the flow of gas through the root clearance results in an increased axial stress on the rotor blades and turbine runner, in inverse proportion to the size of the clearance, chiefly owing to the increase in the load on the runner body. Figures 4; references 2 (Russian).
[498-1386]

USSR

UDC 539.3.534.121.2

INFLUENCE THAT INTERNAL PRESSURE HAS ON THE FREQUENCIES OF A SPHERICAL SHELL

Moscow IZVESTIYA VUZov: MASHINOSTROYENIYE in Russian No 10, 1979
pp 30-34 manuscript received 7 Jul 78

VEREMICHEV, A. N., graduate student, and STYTSYNA, V. K., candidate of technical sciences

[Abstract] An examination is made of free oscillations of a spherical shell filled with a compressible liquid in the presence of internal pressure. The problem is solved by the technique of superimposing small additional deformations on the fundamental deformed state. It is assumed that the shell is made of a linearly elastic material. Equations are derived for the frequencies of oscillations of the shell. Accounting for internal pressure leads to terms with a coefficient that increases with increasing pressure. References 4 (Russian).
[419-6610]

THEORETICAL DETERMINATION OF TANGENTIAL CONTACT DISPLACEMENTS OF MATING SURFACES

Moscow IZVESTIYA VUZov: MASHINOSTROYENIYE in Russian No 10, 1979 pp 34-39
manuscript received 10 Feb 78

SUSLOV, A. G., candidate of technical sciences, docent

[Abstract] The author considers the tangential contact displacement that occurs between the contacting parts of machines when a shearing force is applied that is less than the force of static friction. Equations are derived for determining these displacements in actual machine components. Analysis of the resultant expressions shows that if the contact convergence of the mating surfaces with elastic-plastic deformations is greater in kinematics than in statics, this convergence will remain practically unchanged when the contact deformations are elastic. The results of the theoretical studies show that contact displacements depend on the normal contact convergences of the machine components, the relative location of machining traces on the mating surfaces and the direction of the shearing force. Figure 1; references 8: 7 Russian, 1 Western.
[419-6610]

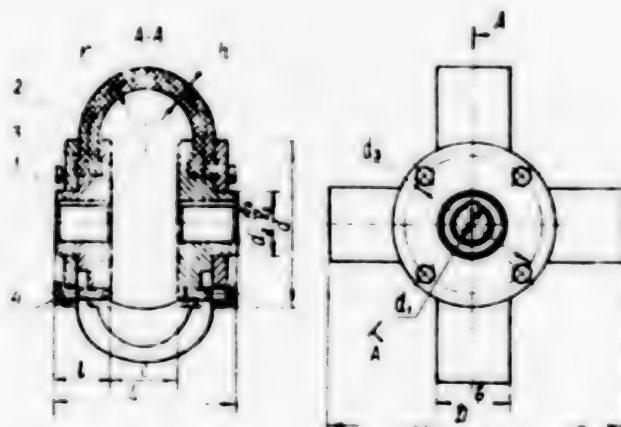
AXIAL COMPLIANCE OF LOBED COUPLINGS WITH RUBBER ELASTIC ELEMENTS

Moscow IZVESTIYA VUZov: MASHINOSTROYENIYE in Russian No 10, 1979 pp 40-42
manuscript received 15 Feb 79

BOGACHEV, V. N., graduate student

[Abstract] The author considers a coupling that consists of two half-couplings 1 (see the diagram), elastic elements (lobes) 2, and pressure rings 3 held against the flanges of the half-couplings by screws 4. The couplings are made in three sizes with lobes numbering from 3 to 12. A method is proposed for approximate calculation of the loads that arise with axial displacements of the coupled shafts. The solution is found on the assumption that the displacements are small and that the material of the elastic elements conforms to Hooke law. The resultant expression for

axial compliance agrees rather well with experimental data for displacements commonly observed in practice. A comparison with results obtained by the theory of flexible rods shows that the latter is more accurate in the region of compression for considerable displacements. Figures 2; references 7 (Russian).
[419-6610]



USSR

UDC 629.7.023.4

THE EFFECT OF SUPPORTING LAYER THICKNESS ON THE STRESS-STRAIN STATE OF SANDWICH SHELLS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian No 5, 1980 pp 11-13 manuscript received 14 May 79

BAKULIN, V. N.

[Abstract] A cylindrical sandwich shell supported by bearing layers on one end was considered during the effect of a radial annular load on the outer bearing layer on the other end. The finite element method with a three-ply rectangular finite element was used to investigate variation of the supporting layer thickness on the stress-strain state of the shell. The parameters of the stress-strain state of both supporting layers decrease with an increase of supporting layer thickness. If the thickness of the inner and outer shells is increased to a value of 0.01, there is a more rapid decrease of the parameters of the stress-strain state of the supporting layers. The intensity of the decrease of displacements and stresses of the supporting layers is reduced with a further increase of the outer and inner supporting layers. The parameters of the stress-strain state in the outer supporting layer are considerably higher than those in the inner supporting layer if the inner layer is thicker than

the outer layer. Variation of the inner supporting layer thickness has a weaker effect on the stress-strain state of the shells than variation of the outer supporting layer thickness. This occurs because the load is applied to the outer supporting layer, which assumes the greater part of the load due to the compressability of the filler in the radial direction. Figures 3; references 2 (Russian).

USSR

UDC 531.36

CHARACTERISTICS OF SLIDING FRICTION IN TRANSIENT MOTION MODES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian No 5, 1980 pp 27-30 manuscript received 16 Jan 78

SHMAKOV, V. A. and KHITRIK, V. E.

[Abstract] The transient characteristics of sliding friction which relate the instantaneous value of the frictional force to the instantaneous values of the kinematic parameters of the system and the main dynamic parameters of the system during motion of an elastic system at irregular speed in the range of 0.33 microns/s to 25 mm/s were constructed. Disregard of the dissipative force does not result in any significant errors in determination of the frictional force since the logarithmic decrement of attenuation in the drive does not exceed 0.04. There is qualitative conformity between dry friction and friction of similar pairs under boundary lubrication conditions according to the nature of motion. The contacting bodies have significant relative displacement in the contact phase. The transient characteristics of sliding friction can be interpreted as a set of two-valued functions of the sliding rate dependent on the dynamic parameters of the system. The transient characteristics of friction are described mathematically. Figures 3.

THE EFFECT OF VOLUMETRIC ABSORPTION OF RADIANT ENERGY ON THE TEMPERATURE STATE OF SHELLS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, MASHINOSTROYENIYE in Russian No 5, 1980 pp 61-63 manuscript received 20 Jul 78

YELISEYEV, V. N. and KHANEYEV, YU. P.

[Abstract] The effect of radiant energy absorption by the semitransparent material of shells on the temperature state of gas-discharge sources of high-intensity radiation was investigated. The temperature field of the shell of a high-intensity radiation source exposed to radiant-conductive heating by energy reaching its inner surface from a plasma and cooled by liquid on the outside could be determined by solving a boundary-value problem. The solutions can be used to determine the limits of applicability of the assumption of negligibly small effect of radiant energy absorption in shells of high-intensity radiation sources made from various materials and operating in different modes. Figures 3; references 2 (Russian).

EFFECT OF ACCELERATIONS ON THE TORQUE CHARACTERISTICS OF THE SUSPENSION OF A QUASISPHERICAL SUPERCONDUCTING ROTOR

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979 pp 58-61 manuscript received 16 Oct 78

URMAN, YU. M. and RUSHEVA, T. V., Scientific Research Institute of Applied Mathematics and Cybernetics at Gor'kiy State University imeni N. I. Lobachevskiy

[Abstract] The effect of accelerations on the torque characteristics of the axisymmetrical suspension of a quasispherical superconducting rotor is examined. A formula for the k -th harmonic of the force function averaged over free Euler-Poinsot motion is presented for the case in which the acceleration vector and the field axis of symmetry-compose the angle $\gamma \neq 0$. In cases in which the axis of symmetry of the suspension and the acceleration vector do not coincide in direction, the rotor's center of mass no longer is aligned with the axis of symmetry of the suspension. In such cases the force tensor has three components instead of one. In this connection, the components of the force tensor of twin-coil suspensions of ellipsoidal and pear-shaped rotors are analyzed and calculated with the aid of a computer. Figures 2; references 3 (Russian).

[13-1386]

USSR

UDC 539.3:534.1

RESONANT FREQUENCIES OF SHELLS OSCILLATING IN AN INFINITE FLUID

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 869-876 manuscript received 2 Jan 79

POPOV, A. L. and CHERNYSHEV, G. N., Moscow

[Abstract] A study is made of the stable oscillations of a closed shell in a compressible fluid. It is considered that the form of the oscillations is primarily flexural (quasi-transverse) described by the equations of the rapidly changing stress-strain state. Particular emphasis is given to the case in which the shell is spherical. Equations are derived which can be used to find the resonant frequencies of high frequency oscillations of a complex closed shell of arbitrary shape immersed in a compressible fluid, as well as the rate of attenuation of acoustic pressure with increasing distance from the shell. Figure 1; references 7 (Russian). [486-6508]

USSR

UDC 539.3:534.1

THE EXCITATION OF NORMAL AND ATTACHED WAVES IN AN INFINITE MULTILAYER ELASTIC STRIP

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 877-886 manuscript received 20 Nov 78

KRASNUSHKIN, P. YE., Moscow

[Abstract] Forced harmonic oscillations in an infinite multilayer elastic strip are studied. The sequence of the study is as follows: the initial boundary-value problem is stated and reduced to canonical form; the solution of the boundary-value problem is expanded with respect to normal and attached waves traveling along the strip; the primary properties of the normal waves are determined; dispersion equations are derived for the normal waves; and the overall picture of forced oscillations of the elastic strip is determined. References 20: 19 Russian, 1 Western. [486-6508]

USSR

UDC 539.383

CONTACT PROBLEMS OF FORCED STABLE OSCILLATIONS OF BEAMS ON AN ELASTIC STRIP, HALF STRIP AND RECTANGLES

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 902 manuscript received 15 Jan 79

BATEN'KOVA, YE. YU., ZIL'BERGLEYT, A. S. and NULLER, B. M., Leningrad

[Abstract] Dynamic problems from the theory of elasticity are studied for a strip, half strip and rectangle partially reinforced with beams of constant rigidity. The solution is constructed in a form which is well adapted for compilation of vibration loading of a foundation and the supporting beams of the slabs of framework structure. The question of the uniqueness of the solutions produced is addressed. References 23 (Russian).
[486-6508]

USSR

UDC 531.381:534

OSCILLATIONS OF A SOLID AROUND STABLE PERMANENT ROTATIONS

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 945-948 manuscript received 19 May 78

APYKHTIN, N. G., Moscow

[Abstract] The amplitudes and frequencies of oscillations of a solid around stable permanent rotations are determined in the Euler, Lagrange and Kovalevskaya approximation by conversion to normal coordinates and replacement of nonlinear terms in the equations of motion with their integral averages with respect to the periods of the angular variables. The study is performed for equations of disturbed motion of a solid in homogeneous or central Newtonian force fields. Reference 1 (Russian).
[486-6508]

THE USE OF A MULTILAYER VISCOELASTIC MEDIUM AS A CALCULATION SYSTEM FOR
ESTIMATION OF THE STRESS STATE OF THE PAVEMENT COVERING HIGHWAYS AND
ROADWAYS WITH MOVING LOADS

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 10, Oct 79 pp 50-57
manuscript received 10 May 77

RADOVSKIY, B. S., State Scientific Research Institute for Roads, Kiev

[Abstract] The pavement covering a highway or airfield runway is looked upon as a viscoelastic plate of thickness h_1 and unlimited area resting without friction on a homogeneous viscoelastic half space. The process of deformation of the structure is considered quasistatic. The materials of the plate and half space are considered linearly viscoelastic. The load is considered to be moving but always perpendicular to the plane of the plate, evenly distributed over the area of a circle of a size equal to the contact patch between the tire and the pavement. The vertical movement of the plate, the vertical perpendicular stress at the interface between the plate and half space and horizontal normal stress resulting from bending of the plate are determined. The solution of the resultant quasistatic problem is acceptable for the study of the stress-strain state of the pavement of roads and runways for speeds up to about 150 km/hr. Figures 2; references 11: 9 Russian, 2 Western.
[488-6508]

PLATES AND SHELLS OF VARIABLE THICKNESS

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 10, Oct 79 pp 60-64
manuscript received 17 Apr 78

CHEREPA NOV, G. P. and KULIYEV, S. A., Azerbaijan Institute of Construction Engineering, Baku

[Abstract] This article is an exposition of the theory of thin elastic shells of variable thickness, including the equations of equilibrium, the equations describing Hooke's law and geometric equations. Errors which develop due to analysis of such systems using the equations presented are determined. In the case of plates with piecewise-constant thickness, it is noted, the problem is reduced to two related, sequentially solvable problems of the classical two-dimensional theory of elasticity of a homogeneous isotropic body. References 2 (Russian).
[488-6508]

USSR

UDC 539.3

DETERMINATION OF CRITICAL STRESSES OF AXIAL COMPRESSION FOR A MULTILAYER CYLINDRICAL SHELL SUPPORTED AT ITS ENDS BY ELASTIC RIBS

Kiev PRIKLADNAYA MEKhanika in Russian Vol 15 No 10, Oct 79 pp 64-69
manuscript received 11 Sep 78

PROKOPENKO, N. YA., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] A study is made of a thin closed multilayer cylindrical shell resting on elastic ribs and subject to uniformly distributed axial compressive stresses. This shell has constant thickness and consists of an arbitrary number of orthotropic layers. It is assumed that the layers remain elastic upon deformation and work together without slipping, that the hypothesis of undeformable normals is applicable to the entire packet, and that the primary directions of elasticity coincide with directions of the coordinate lines of the midsurface of the shell. The problem of determination of critical axial compressive stresses is reduced to determination of the least value of stress for which the determinant of a derived system of equations vanishes. A numerical example is appended. Figures 5; references 6: 4 Russian, 2 Western.
[488-6508]

USSR

UDC 539.3

THE STRESS STATE OF THICKWALL CORRUGATED SPHERICAL SHELLS

Kiev PRIKLADNAYA MEKhanika in Russian Vol 15 No 10, Oct 79 pp 128-133
manuscript received 29 Feb 78

CHERNOPIISKIY, D. I., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] A study is presented of the axisymmetrical stress state of thickwall corrugated shells which are near spherical in shape under the influence of static forces. The three-dimensional problem of elastic equilibrium of a body limited by an inner and outer surface is studied. The solution is reduced to solution of sequential boundary-value problems of the theory of elasticity for spherical shells. Figures 3; references 11: 9 Russian, 2 Western.
[488-6508]

THREE-DIMENSIONAL STRESSED STATE OF AN OPEN SPHERICAL SHELL

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 11, 1979 pp 38-45

manuscript received 23 Dec 77

PODIL'CHUK, YU. N. and GOLOBOROD'KO, S. A., Kiev, Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] The axisymmetrical problem of a hemispherical single-layer rigidly edge clamped shell is investigated from the standpoint of the exact formulation of three-dimensional elasticity theory. Four particular solutions of equilibrium equations, each satisfying the conditions of rigid clamping of the shell, are constructed. It is shown that the problem of satisfying the boundary conditions at the inner and outer surface of the shell reduces to the solution of an infinite linear system of algebraic equations. The stressed state of a hemispherical shell under uniform external pressure is analyzed by way of an example: numerical information on that state is then obtained by determining the unknown constants from the solution of the infinite system of equations (a system of 50 equations was solved) and thereupon by computing the components of the stressed state. A table comparing the stress components for an open shell with their counterparts for the corresponding closed spherical shell is presented. Figure 1; references 2 (Russian).

[11-1186]

DYNAMIC BUCKLING OF RECTANGULAR-PLANE SHELLS UNDER FINITE BENDING STRESSES

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 11, 1979 pp 58-62 manuscript received 27 Jun 77

FRYS'KO, V. A., Saratov Polytechnical Institute

[Abstract] A new dynamic criterion for assessing the buckling of shells under critical loads is introduced. The criterion, which complements the existing criteria reflecting the various aspects of the buckling of shells, minimizes computer time needed to determine the critical load. The criterion is based on an analysis of the polarity of the square β of the frequency of natural oscillations of the perturbed motion of the system about the initial state of the shell (there exists an infinite set of such natural frequencies for every time instant, and their spectrum is discrete). It is shown that the polarity of β can be used as the criterion for determining whether the system is in a stable or an unstable state, since stability exists if all β are positive and is

as in all other cases. The initial state of structures is determined through the solution of a nonlinear system of motion of slightly curved shells with low shear rigidity. Zones of instability in the process of certain values of physico-geometrical parameters are determined for specified shapes of shells. Figures 2; references 7: 5 Russian, 2 Western. [13-1386]

USSR

UDC 539.3

STRESS-STRAIN CONDITION OF AN ORTHOTROPIC SPHERICAL SHELL UPON INSTANTANEOUS OPENING OF AN APERTURE THEREIN

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 11, 1979 pp 63-67 manuscript received 22 Jun 77

VALIULLIN, A. KH., Kazan' Chemico-Technological Institute

[Abstract] The oscillations that arise upon the instantaneous opening of a circular aperture in an internally loaded thin orthotropic spherical shell are investigated, as is the attendant dynamic stress-strain condition of the shell. The problem is solved on the basis of zero-moment equations of axially symmetric motion of a shell element upon utilizing linear geometric formulas, the Kirchhoff-Love hypotheses, and the Hooke law governing orthotropic bodies. The following boundary conditions apply: meridional motion is absent at the equator, and meridional stress instantaneously disappears at the edge of the orifice being opened. The differential equations of motion are solved numerically by the finite-difference method; implicit approximation with subsequent iterative determination of movements is applied for this purpose. The calculations show that the dynamic stresses arising in the shell at the edge of the aperture exceed the stresses due to internal pressure by a factor of approximately 2.5-3 times. Figures 2; references 2 (Russian). [13-1386]

USSR

UDC 533.6.013.62

INVESTIGATION OF TRANSIENT PROCESSES IN A FLUID-CONTAINING CYLINDRICAL SHELL UPON ITS IMPACT EXCITATION

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 11, 1979 pp 68-75 manuscript received 28 Feb 79

KOVALENKO, A. P., Kiev, Institute of Mechanics, USSR Academy of Sciences

[Abstract] A distinguishing and relatively uninvestigated feature of the motion of the system "cylindrical shell-ideal compressible fluid" in the presence of a dynamic load applied to one of its ends is that the perturbations propagate in the shell material at a speed greater than the speed of sound in the fluid. As a result, allowance must be made for the reciprocal effect of motion of elements of such a system. In this connection, a procedure for investigating transient processes in such systems is presented. The procedure combines the approximate analytic method for the solution of a system of differential equations in an image space with the numerical Laplace transform inversion method for dynamic models of Timoshenko-type shells. Transient processes in the system are investigated from this standpoint over a finite interval of time in the presence of an impact applied to a rigidly attached wall. It is shown that, ahead of the perturbation front in the fluid, which propagates at the speed of sound in the fluid--but at a greater speed in the shell material--the fluid particles will not be at rest and thus the fluid will markedly affect the pattern of motion of the shell, by either magnifying or reducing the radial displacement of the shell. In its turn, the motion of the shell's walls, under certain conditions, results in changing the fluid pressure distribution so that either the fluid gets separated from the shell's walls or cavitation bubbles arise. Figures 4; references 11: 10 Russian, 1 Western.
[13-1386]

USSR

UDC 539.3

A VARIANT OF THE NON-CLASSICAL THEORY OF SLIGHTLY CURVED MULTIPLE-LAYER SHELLS AND PLATES

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 15 No 11, 1979 pp 76-81 manuscript received 29 Dec 78

PISKUNOV, V. G., Kiev Automotive and Highway Institute

[Abstract] A variant of the theory of multiple-layer slightly curved shells and plates consisting of transversally isotropic layers is proposed. Hypotheses that allow for the effect of cross displacement and static and

dynamic compression are introduced. With the aid of these hypotheses and on the basis of the Ostrogradskiy-Hamilton variational principle, the three-dimensional problem of elasticity theory is reduced to its two-dimensional counterpart. The equations derived are in agreement with the kinematic formulas ensuing from the hypotheses. Sample solutions of static and dynamic problems on this basis are presented, demonstrating that the proposed variant of the theory has a broader applicability than do certain existing refined theories. Figures 2; references 10 (Russian). [13-1386]

USSR

UDC 539.4:629.7.036

FATIGUE STRENGTH OF GAS TURBINE DISKS

View PROBLEM PROCHNOSTI in Russian No 9(123), Sep 79 pp 38-41 manuscript received 18 Oct 78

MAKASHOV, B. F. and PETUKHOV, A. N., Central Scientific Research Institute of Aircraft Engine Building imeni P. I. Baranov, Moscow

[Abstract] The paper gives data on the stressed state of turbine disks in terms of stress concentration, and fatigue tests of disk components. Based on an analysis of these data, an estimate is made of the carrying capacity of the disk when subjected to variable loads. Measurements were taken by strain-gage resistors with a 1 mm base on 30KhGSA steel models 10 mm thick on a scale of 10:1. The tests were done with tensile and bending loads in different planes on the models, and also under symmetric bending, and under symmetric bending combined with static tensile loading at high temperatures on the disk components. Values are found for the effective coefficients of stress concentration and the coefficients that account for the influence of technological factors on fatigue. The test results agree well with the calculated level of the limiting stress amplitude. Figures 3; references 4 (Russian). [4V-6610]

USSR

UDC 678.5:539.37.276

ON THE CARRYING CAPACITY OF SPHEROPLASTIC SPHERICAL SHELLS

Kiev PROBLEMY PROCHNOSTI in Russian No 9(123), Sep 79 pp 86-89 manuscript received 4 Aug 78

KRZHECHKOVSKIY, P. G. and KUZNETSOV, V. V., Nikolayev Shipbuilding Institute

[Abstract] An examination is made of the problem of applying plasticity theory to evaluation of the strength of thick-walled shells made of spheroplastic, which is a system of dispersed hollow spherical shells distributed through a polymer binder matrix. The results of phenomenological determination of the hydrostatic strength of such shells are used to evaluate the reduction in strength of spheroplastic if it contains additional pores in the form of closed spherical bubbles. Figures 4; references 10 (Russian).

[450-6610]

USSR

UDC 534.282:539.67

INVESTIGATION OF SCATTERING OF ENERGY IN THE CASE OF COUPLED BENDING AND TWISTING VIBRATIONS OF RODS

Kiev PROBLEMY PROCHNOSTI in Russian No 9(123), Sep 79 pp 101-104 manuscript received 24 Oct 78

KHIL'CHEVSKIY, V. V. and VASILEVICH, D. I., Kiev Polytechnical Institute, Kirov Polytechnical Institute

[Abstract] Coupled bending and twisting vibrations of load bearing elements arise as a consequence of asymmetry of the cross section of the element where the elastic axis and the axis of the centers of bending do not coincide. Scattering of energy that accompanies these vibrations in rod elements is studied to get a more exact idea of the damping properties of the material in dynamic calculations of machine components and structural elements operating under resonant conditions. The paper gives the results of an investigation of the influence that the ratio of normal and tangential stresses has on scattering of energy accompanying coupled twisting and bending vibrations of rods. A comparison of experimental results for different materials shows that regardless of the physical mechanism of damping with coupled vibrations, the level of energy scattering increases over that for simple bending or twisting vibrations. The degree of increase in energy scattering depends on the basic physical mechanism, the structural state of the material and the ratio of normal to tangential stresses. The greatest increase in energy scattering corresponds to a ratio of unity. Figures 2; references 6 (Russian).

[450-6610]

USSR

UDC 629.7.023:539.3.534.1

Thermoplastic Stresses State of Cylindrical Sandwich Shells

Kiev PROBLEMY PROCHNOSTI in Russian No 10, 1979 pp 3-8 manuscript received 11 Jul 78

GRIGOLYUK, E. I. and OSIPOV, N. L., Moscow Automotive Mechanics Institute

[Abstract] The axisymmetric thermoelastic-plastic stress-strain condition of a thin circular cylindrical sandwich shell is investigated. The solution is obtained by partitioning the loading process into stages and solving the pertinent systems of geometrical and equilibrium equations for each stage. It is concluded that the effect of the temperature field on the stress-strain condition of the shell increases with increasing extent of shear. This is a special feature of sandwich shells containing a filler susceptible to shear, particularly with respect to the thermoplastic stage in the filler layer which causes that layer to become "lighter" than in the presence of elastic deformation, and more sensitive to the pattern of temperature distribution. All this complicates the pattern of the stress condition. Since fracture due to accumulated shear deformations is most likely to occur at the shell edge, disregard of shear deformations in even extremely hard fillers may result in an incorrect idea of the performance of laminated shells. Figures 5; references 13 (Russian). [488-1386]

USSR

UDC 539.319.082.1

Determination of Residual Stresses in Multilayer Cylindrical Parts

Kiev PROBLEMY PROCHNOSTI in Russian No 10, 1979 pp 23-25 manuscript received 9 Jun 78

IGNAT'KOV, D. A., Kishinev Agricultural Institute imeni M. V. Frunze

[Abstract] Residual stresses are inevitable in structural elements fabricated in the form of cylindrical tubes or disks consisting of a large number of rigidly joined layers of different materials. Hence such stresses have to be taken into account. Moreover, analysis of their distribution serves to select the optimal structure of such elements, i.e. the number and sequence of their component layers, so as to enhance their loadbearing strength. In this connection, design formulas for the determination of residual stresses in piecewise-homogeneous cylindrical parts are presented. The derivation of these formulas is based on the

solution of the Lamé problem for a hollow multilayered cylinder. Corresponding formulas for the determination of axial and circumferential stresses are obtained. The presented formulas also are applicable to the determination of residual stresses in multilayered disks. References 5 (Russian).
[488-1386]

1989

UDC 612.766

THE COMFORT PRINCIPLE IN THE DYNAMICS OF BIPEDAL WALKING

Moscow VESTNIK MOSKOVAKOGO UNIVERSITETA SERIYA I MATEMATIKA MEKHANIKA
in Russian No 4, Jul/Aug 79 pp 64-68 manuscript received 26 Oct 77

BELETSKIY, V. V., KOVALEVA, YE. D., and POGORELOV, D. YU., Department of
Theoretical Mechanics

[Abstract] Earlier works experimentally produced graphs of the reaction of the ground supporting a walking man as a function of time. The shape of these graphs was found to be a stable characteristic depending qualitatively very little on the rate of walking or individual parameters of the experimental subject. It is suggested in this work that the shape of the graphs is determined by typical boundary conditions necessary for periodic walking, as well as the "comfort principle," i.e., the fact that either a real human being or a bipedal vehicle tends to walk in a way such that its center of mass experience the minimum accelerations. The problem is stated so that there is no need for a very detailed dynamic model. Only the behavior of global characteristics such as the movement of the center of mass and the change in the moment is of interest. The solution to the mathematical problem as stated agrees qualitatively with the observed phenomenon. Figures 3; references 6 (Russian).
[683-6508]

PERIODIC LYAPUNOV MOTIONS OF A HEAVY RIGID BODY WITH A SINGLE FIXED POINT

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 1, MATEM. MEKH. In Russian
No 5, 1979 pp 75-79 manuscript received 18 May 78

MARINBAKH, M. A., Chair of Theoretical Mechanics [Moscow University]

[Abstract] The problem of determining the principal orientations and the ratio between the semiaxes of the ellipses representing the trajectories of small oscillations of a heavy rigid body in the neighborhood of permanent rotations is investigated. These oscillations represent the first approximation for the periodic solutions of exact equations of motion that can be derived in an adjusted system with the aid of Lyapunov's theorem of the homomorphic interval (the Jacobi integral). The case of dynamic symmetry of the body is analyzed in detail. Figures 3; references 3:

2 Russian, 1 Western.

[495-1386]

USSR

UDC 621.224-233.2

A 'CAPROLON' BEARING FOR WATER TURBINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 12, Dec 79 pp 54-55

DIVIN, I. N., engineer, SOSUNOV, V. V., engineer, and ZHIROV, V. YE., engineer, Kizelovskaya State Regional Electric Power Plant No. 3

[Abstract] The first bearing with an insert made of a new plastic material "caprolon" had been installed by the end of 1977 in the RO 123-VM-275 water turbine of the Shirokovskaya State Electric Power Plant. This material conforms excellently to roughness of the shaft journal. It features a low friction coefficient but also a low thermal conductivity, thus requires film cooling with lubrication. The bearing was tested in the turbine and lasted for about 6,000 h under various modes of operation of the latter, ranging from acceleration to half- or full-load and synchronous compensation. Cooling and lubricating water was pumped into twelve 10 mm wide and 5 mm deep grooves under a pressure of 0.7-1.0 kgf/cm². A "caprolon" bearing is machined on a lathe at a cutting rate of 0.1-0.5 mm/rev and a feed rate of 100-250 m/min, it should have a Claiff 7-8 surface finish. Preliminary data indicate that such a bearing can have a service life of 25-30 years, with 5-6 overhauls, as compared with the 5 years of a wood-plastic bearing.

[8-2416]

USSR

UDC 621.326.536

NEW TUNGSTEN-FILAMENT PYROMETER LAMPS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 9, Sep 79 pp 43-44

VDOVIN, N. S., GRACHEVA, T. I. and NIKULIN, M. M.

[Abstract] A brief description of new pyrometer lamps TRV 2273, TRV 2273-1, TRV 1873 and TRV 1873-1 with tungsten foil filaments 0.05 mm thick and 7 and 10 mm wide. The vertical section of the filament is 35 mm long, and the end sections are 14 mm long. The four-digit number is the designation denotes the limits of reproduction of brightness temperatures in kelvins. The 2273-1 and 1873-1 models have S52-1 sapphire view ports instead of the glass used in the base models. The view ports are 50 mm in diameter and are set at an angle of 5-10° to the plane of the filament to prevent interference from reflections. The lamps are filled with high-purity argon to a pressure of $(850-930) \cdot 10^2$ Pa. Manufacturing details are

given, and a table is presented showing the current-voltage characteristics of the lamps and the corresponding brightness temperatures. Temperature instability of the TRV 2273 model is 10-20°C over a 1000 hour operation period, while the corresponding instability for the TRV 1873 model is 10°C for 500 hours of burning. References 5 (Russian). [421-6610]

USSR

UDC 621.316.825.019.3

INFLUENCE THAT THE MEDIUM HAS ON THE CHARACTERISTICS OF THERMAL RESISTORS BASED ON SILICON WHISKERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 9, Sep 79 pp 44-47

DROZHZHIN, A. I., SEDYKH, N. K. and NOVOKRESHCHENOVA, YE. P.

[Abstract] An examination is made of the influence that various media have on the characteristics of quick-response thermal resistors based on silicon whiskers. The purpose of the study is to determine the possibilities for using these resistors as the sensing elements in instruments that work on the linear section of the current-voltage curve and in the self-heating mode. Tests were done in a vacuum of $\sim 5 \cdot 10^{-3}$ Pa, in quiet air, in distilled water, in alcohol and in gasoline at temperatures of 300-1070, 300-830, 300-370, 300-350 and 300-350 K respectively. The test results show that these resistors can be used for measuring pulsed and rapidly changing temperatures in various media under weak currents that do not permit self-heating. When taking measurements in liquids, it is necessary to avoid strong superheating of the resistor (in the heat-loss anemometer regime), without allowing boiling of the liquid in the surface layer, which leads to additional measurement error. Thermal destruction of the resistors is observed in water when stable heat exchange is disrupted. The stability of parameters of the thermal resistors is improved by annealing for 0.5 hour at ~ 800 K. Figures 4; references 6 (Russian). [421-6610]

A HIGH-SPEED ANALOG-DIGITAL SLIP METER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 9, Sep 79 pp 58-60

KOVALEV, A. M.

[Abstract] Conventional digital slip meters are based on stroboscopes, and are semiautomatic instruments. These devices are not applicable for studying transient processes in induction machines since the measurement time is measured in the tens of seconds. Besides, the instruments are complicated and are not highly accurate since frequency adjustment and measurement are not simultaneous operations. This article describes an instrument in which these disadvantages are almost totally eliminated. A photoelectric converter changes the shaft speed of a motor to square pulse recurrence rate. A line voltage shaper produces square pulses on the line frequency. A special converter shapes pulses with duration equal to the reciprocals of these frequencies. The working cycle consists of corrections over the period of these two durations respectively. A comparison counter records the number of pulses proportional to the slip. The proposed slip meter was developed at the Smolensk Affiliate of Moscow Institute of Power Engineering, and utilizes series 140 and 155 integrated circuits for induction motors on industrial frequency with a slip range of 0-10 and 0-30%. Measurement time is 0.1 s, and principal error is 0.2%. Figures 2; references 1 (Russian). [421-6610]

ANALYSIS OF ERRORS DUE TO POLAROID INCLINATIONS IN TORSION MEASUREMENT SYSTEMS

Leningrad IZVESTIYA VUZov: PRIBOROSTROYENIYE in Russian No 9, 1979
pp 82-86 manuscript received 16 Oct 78

MUSYAKOV, V. L., Leningrad Institute of Precision Mechanics and Optics

[Abstract] At oblique incidence of rays on the polarization elements of torsion angle measurement systems-the mutual alignment of the polarizer and analyzer corresponding to minimum transmittance deviates from their crossed position at normal incidence of rays. This results in errors of torsion measurement. These errors are now analyzed for the systems that include a polarizer and an analyzer represented by polaroid film enclosed in protective glass. Analytic formulas for the determination of these errors are derived and the effect of the polaroids is compared with that of the polarizing prism. The comparison indicates that in the presence of inclinations (turns about the axes perpendicular to the axis of torsion) the use of polaroids in lieu of prisms as polarizing elements may reduce the errors by 30-35%. Figures 4; references 3 (Russian).
[12-1386]

SUPPRESSION OF EXCESS LIGHT NOISE IN POLARIMETRIC MEASUREMENTS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 8, 1979 pp 810-812
manuscript received 4 Apr 79

ZAPASSKIY, V. S.

[Abstract] The sensitivity of polarimeters is chiefly limited by the excess noise of the luminous flux. In this connection, a simple method for amplifying the rotation angle of the plane of polarization (RAPP), serving to markedly reduce the excess noise of the luminous flux is proposed. It is shown that the amplification of RAPP is readily achieved by means of a linearly dichroic medium or any other partial linear polarizer. The light that had been originally linearly polarized along the x-axis acquires the E_y -component but attenuating the intensity of the E_x -component by a factor of k times, then the acquired rotation of the polarization plane will increase by a factor of k times. The resultant gain in RAPP will not improve the signal/noise ratio in polarimetric measurements in the presence of pure shot noise of the receiver photocurrent, but it will improve that ratio in the presence of excess noise

of the luminous source. When combined with a photorecording compensation circuit, this technique serves to maximize sensitivity when using light sources whose noise exceeds shot noise by a factor of 4.5. Figure 1; references 1 (Russian).

USSR

UDC 621.383

TRANSFER CHARACTERISTICS OF SCANNING TELEPHOTOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 1-2 manuscript received 16 Aug 78

CHUBAKOV, L. G., SHUBA, YU. A. and YATSYK, V. S.

[Abstract] Transfer characteristics of a scanning telephotometer which determine the image fidelity include the scattering function of its objective and the sensitivity function of its receiver. Here the sensitivity distribution, after normalization and with the aid of a Fourier transform is shown to yield a spatial-frequency transfer coefficient and a spatial transfer coefficient in two angular coordinates as well as a frequency transfer coefficient relating the output signal to the input intensity. Figures 2; references 3 (Russian).
[7-2415]

USSR

UDC 535:551.311.243

CONTACT PROBLEMS IN SHAPING OF OPTICAL SURFACES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 8-10 manuscript received 11 Jun 78

BOGDANOV, A. P. and TSESNEK, L. S.

[Abstract] The wear of surfaces in contact during their relative motion is considered, a problem which arises in the mechanical treatment of optical elements. On the basis of the fundamental law of wear and the equation of elastic contact, dynamic integral relations are derived for the amount of wear as a function of time in the case of the optical surface and the tool both almost but not quite spherical. The optical element is assumed to rotate about its axis and rub against the tool, the latter rotating about its axis and also moving along the surface of the element driven by a centrally acting force which varies as a function of time. Another force, also varying as a function of time, presses the

tool along its axis against the surface of the element. The resulting expressions provide the theoretical basis for analysis and control of surface shaping processes such as grinding of mirrors. Figures 2; references 6 (Russian).

[7-2415]

USSR

UDC 535.36.089.68

MEASUREMENT OF THE SCATTERING MATRIX OF BODIES WITH A MIRROR SPHERE AS THE REFLECTION REFERENCE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 11-12 manuscript received 16 Aug 78

TEVYASHOV, V. I., TYMKUL, V. M. and SHUBA, YU. A.

[Abstract] It can be shown, on the basis of Fresnel relations, that a mirror sphere is preferable to a plane diffusing surface as the reflection reference for measurement of the scattering-intensity matrix of intricately shaped bodies. Such a body must in this case be illuminated independently with three linearly polarized light beams at azimuthal angles of respectively 0° , 90° , 45° to the reference (scattering) plane and a clockwise-circularly polarized light beam. These four measurements will yield all the necessary 16 matrix elements. References 8 (Russian).

[7-2415]

USSR

UDC 631.384.32

QUALITY CRITERIA FOR RADIATION RECEIVERS IN TELEVISION SYSTEMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 12-14 manuscript received 11 Nov 78

GALIAKBEROV, D. SH., DOROFYEV, V. A., LOKUSTNIKOV, A. I. and OVSYANNIKOV, V. A.

[Abstract] The conventional quality criterion for selection of radiation receivers for any television system

$$Q = \Delta \log \lambda_{\text{eff}} D_m^* (1 - e^{-\tau/T})$$

(D_m^* denoting the photoreceiver detection power, T denoting the photoreceiver time constant and τ denoting the minimum duration of an input pulse) is inadequate, inasmuch as it refers to the sensitivity threshold

only without reference to the resolving power. A receiver can be regarded optimal, if it maximizes the quality criterion for the entire television system

$$M = \frac{1}{\Delta T_0 \Delta \psi_0}$$

(the sensitivity threshold ΔT_0 being the temperature drop in a large perfectly black body which will produce a signal-to-noise ratio $S/N=1$, and the resolution threshold $\Delta \psi_0$ being the angular width of the system response, measured at the peak level, to a point source of radiation). Combining the two, with proper substitutions for all the quantities involved, yields a much more complete and precise quality criterion for radiation receivers

$$Q = \Delta \log \lambda_{\text{eff}} D_m^* \sqrt{(1 + \omega_0^2 T^2)(1 + \omega_1/\omega_0)} \frac{10^{-0.6\omega_1\tau}}{1.6 + (T/\tau)^{1.5}}$$

(ω_0 denoting the nominal frequency of modulation of the radiation flux at which a photoreceiver is rated, and ω_1 denoting the frequency at which the white component of noise becomes equal to the hyperbolic component). Figures 3; references 3 (Russian).
[7-2415]

MEASUREMENT OF OPTICAL CONSTANTS IN POLARIZED LIGHT AT ONE INCIDENCE ANGLE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 14-17 manuscript received 18 Feb 78

MOROZOV, V. N., SHAKARYAN, E. S., MOLOCHNIKOV, B. I., LEYKIN, M. V. and
ZOLOTAREV, V. M.

[Abstract] Determination of both the refractive index and the absorption coefficient of optical media is possible from the reflection parameters, according to Fresnel relations, with the reflection coefficient having been measured with perpendicularly polarized light and with parallel polarized light at the same incidence angle both, or with perpendicularly polarized light only but at two different incidence angles. Here the first method is considered. A general relation for the complex refractive index, including as its imaginary part the absorption coefficient, is derived for the case of natural light with polarization in both principal directions. An algorithm has been developed which also evaluates the measurement error. The results of calculations indicate the optimum incidence angles, depending on the nominal values of n and κ , also that measurements are more accurate under conditions of imperfect total internal reflection than with external reflection. Figures 5; references 5:

4 Russian, 1 Western.

[7-2415]

A MULTICHANNEL APPARATUS FOR ANALYZING A SUBSTANCE ON THE BASIS OF ATOMIC SPECTRA

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 18-21 manuscript received 1 Nov 78

ABRAMSON, I. S., ASTAF'YEV, P. N., MOGILEVSKIY, A. N., SLAVNYY, V. A.,
SUBOCHEV, A. I. and FABELINSKIY, YU. I.

[Abstract] Preliminary studies have been made toward development of a multichannel apparatus for analyzing a substance on the basis of atomic spectra. Its operation involves periodic scanning of a spectrum and recording the lines. It can operate with either absorption or emission spectra, scanning them in the 3-step mode at a frequency as high as 250 Hz. Operation with double modulation, simultaneously recording absorption and emission signals from elements, is possible in the case of high-temperature atomizers so that distortion of absorption measurements by emission from the absorption cell itself can be eliminated. The

apparatus consists of a conventional light source with a luminaire, an optical chopper disk, a polychromator taken from an MSF-4 quantum meter, an atomizer with an absorption cell, a scanner, a 12-channel receiver-recorder, a commutator, and a digital voltmeter coupled to a control with a printout. Preliminary tests have yielded results for 11 heavy metals which are accurate within hundredths of a percent over the 210-25 nm range and within thousandths of a percent over the 270-360 nm range. The detection threshold here is only 2-4 times higher than that in a "Saturn" 2-beam spectrophotometer. Figures 2; tables 1; references 9: 7 Russian, 2 Western.
[7-2415]

USSR

UDC 681.786.23:681.327.12

SERVOMECHANISMS FOR AUTOMATIC FOCUSING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 21-24 manuscript received 6 Oct 78

KOKULIN, F. I. and POLESHCHUK, A. G.

[Abstract] The authors have built and experimentally evaluated two servomechanisms for automatic focusing of the illumination on the surface of a specimen under a photoelectric microscope. They are a piezoelectric one with piezoceramic plates rather than cylinders and an electrodynamic one with a loudspeaker-type permanent magnet and a coil, both consisting of a movable part carrying the objective inside a stationary structure. Their design ensures much less misalignment during sliding of the objective and a much higher sensitivity than conventional servomechanisms. The static characteristic, displacement of the objective as a function of the control voltage, was measured with a laser gauge and found to be linear for the electrodynamic servomechanism but nonlinear with hysteresis for the piezoelectric servomechanism. The frequency characteristic, amplitude of displacement as a function of the frequency characterizing the response speed, was measured with parallel laser rays passing through special optics. That of the piezoelectric servomechanism was found to be flat up to 100 Hz and then to drop with increasing frequency. That of the electrodynamic servomechanism was found to peak sharply at 150 Hz, but the peak could be shifted to 1000 Hz by means of a damper. The piezoelectric servomechanism is preferred when the surface of the test object has a roughness characterized by a high frequency and a low amplitude; however, the frequency range is limited by the first resonance. Figures 4; references 6: 5 Russian, 1 Western.
[7-2415]

THE IRF-454 REFRACTOMETER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 24-26 manuscript received 4 Oct 78

ISKHAKOV, B. O., GATULLIN, G. A., MOLOCHNIKOV, B. I., MITINA, G. G.,
PETRANOVSKIY, N. A. and RAGINOVA, M. A.

[Abstract] The authors have built an Abbe refractometer capable of measuring accurately, with $\pm 2 \cdot 10^{-4}$, refractive indexes n_D not only within the most common 1.3-1.7 range but also smaller than 1.3 (organosilicon fluids) and larger than 1.7 (immersion fluids and high-refractivity glass). The readings of this IRF-454 instrument can fluctuate within $1 \cdot 10^{-4}$, the maximum error of the mean dispersion is $\Delta(n_F - n_C) = \pm 1.5 \cdot 10^{-4}$. The instrument includes an illuminating prism, a measuring prism, a pair of Amici AP-90 achromatizing prisms, an ocular, an objective, a lens, a grating, a diverting prism, a filter, four mirrors, and a scale with two ranges and $1 \cdot 10^{-3}$ divisions on each. Different measuring prisms are used for the $n_D = 1.2-1.6$ range and the $n_D = 1.6-2.0$ range respectively, for the latter a prism made of superheavy flint glass. An ultrathermostat is provided for the test substance, with 10-35°C and 35-60°C thermometers checking the test temperature. The instrument has been calibrated and certified. Figures 4; tables 1; references 3: 1 Polish, 2 Western.
[7-2415]

COMPARATIVE STUDY OF EMISSION CHARACTERISTICS OF NEODYMIUM GLASSES FOR LASER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 27-29 manuscript received 4 Oct 78

AVAKYANTS, L. I., BUZHINSKIY, I. M., GEYCHENKO, S. F., KORYAGINA, YE. I.
and SURKOVA, V. F.

[Abstract] The influence of laser components on the emission characteristics of neodymium glasses was evaluated in a comparative study covering several silicate and phosphate grades, also a quartz grade, under the same operating conditions. Measurements have revealed the dependence of the emission energy on the pumping energy from the laser lamp and on the reflection coefficient at the laser mirror, the dependence of the efficiency

of generation of active elements on the level of their inactive absorption, and the maximum pumping power not causing a breakdown of active elements as well as the maximum power output at that pumping limit. The silicate grades GLS4, LGS59-5 and the phosphate grade LGS56 are found to have the highest load capacities among the respective groups of glasses. Figures 5; tables 1; references 5 (Russian).
[7-2415]

USSR

UDC 666.1.035.2

PRODUCTION OF LENS BLANKS WITH SMALLER MACHINING ALLOWANCES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 30-32 manuscript received 23 Aug 78

SHTANDEL', S. K., KOVALENKO, A. I. and ARKHIPOV, O. N.

[Abstract] A method has been developed for producing lens blanks with smaller machining allowances. The hot glass mass is molded without having been in contact with backup plates prior to application of pressure so that "fireclay" surface defects are avoided and the subsequent extrusion process is facilitated. The method is already used for producing convex and concave surfaces as well as flats and bevels with TF, F, OF, LF grades of optical glass. A statistical analysis of 935 production samples has revealed a practically normal distribution of blank thicknesses. On this basis, the necessary allowance for subsequent machining has been established as 0.6 mm. GOST 13240-67 requiring an allowance of 1.5 mm is being revised accordingly. Figures 3; tables ; references 3 (Russian).
[7-2415]

USSR

UDC 771.534.53

ACCURACY OF MEASUREMENT OF OPTICAL DENSITY WITH AN OPTICAL WEDGE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 41-42 manuscript received 29 May 78

SHALAMAY, M. V., SOROKIN, V. P. and SKORTSOV, V. N.

[Abstract] Optical wedges acting as gray light attenuators are used in measurement of the optical density of photographic materials by the differential method. Wedges made of grade NS9 neutral glass do not scatter light, as do wedges made of colloidal graphite or silver, but they

absorb light quite nonselectively and thus introduce an error. This error due to such an NS9 glass wedge in a photoreceiver has been evaluated by correlating the theoretical spectral sensitivity of such a receiver with photometric experiments with and without corrective filters, then calibrating against the spectral sensitivity of the eye. A calibration according to the law of distances squared will ensure an accuracy with ± 0.02 of densitometers and microdensitometers using such wedges. Figures 2; references 4 (Russian).
[7-2415]

USSR

UDC 621.382.323

A PHOTOAMPLIFIER WITH DYNAMIC COMPENSATION OF THE TEMPERATURE DRIFT OF THE CONSTANT COMPONENT IN A PHOTORECEIVER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 43-44 manuscript received 10 Mar 78

SEBKO, S. YE. and KLIMASHIN, V. P.

[Abstract] A photoamplifier is described which includes compensation of the temperature drift so that the constant component of the photoreceiver load will not change. This is achieved by dynamic selection and storage of the compensating voltage between amplification and compensation cycles. The device consists of two differentially connected photodetectors with four transistor switches, a differential input stage with three transistors, two operational amplifiers, and a 2-channel commutator with three transistors (pnp, npn, pnp). A shift of the null level in the amplifier due to temperature drift is cancelled dynamically between commutator operating cycles, also the initial null drift due to operational amplifiers is cancelled in the process, by grounding the photodetectors on the output side and thus generating a voltage sent through a feedback circuit to one of the operational amplifiers. The entire system is switched from signal amplification mode to error storage mode back and forth, with the instantaneous feedback voltage stored by a capacitor till the photoamplifier returns to normal operation as the input of the differential input stage has been ungrounded. This photoamplifier is used in a 2-beam interferometer. Figures 1; references 3 (Russian).
[7-2415]

USE OF GAS-DISCHARGE TUBES FOR MEASURING THE TIME RESOLUTION OF PHOTO-RECEIVERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 44-46 manuscript received 25 Sep 78

IVANOV, V. I., KONSTANTINOV, N. A., PLESHANOV, YU. V., FRATINI, T. A. and
KHOMUTOVA, L. A. (deceased)

[Abstract] The time resolution of semiconductor radiation receivers used with pulse lasers operating at wavelengths longer than $1\text{ }\mu\text{m}$ depends largely on the spectral composition of the radiation, especially near the limit of intrinsic absorption for the semiconductor material. For any given pulse duration, therefore, the time resolution of a photoreceiver can thus become worse in one than in another spectral range. This factor was considered in a study made to determine the feasibility of using a xenon pulse-discharge tube for an evaluation of the time resolution of germanium avalanche photodiodes as receivers of $\lambda = 1.06\text{--}1.7\text{ }\mu\text{m}$ radiation. Measurements were made with an SF-4 spectrophotometer, a photomultiplier and a diaphragm behind it, and an oscillograph. The temperature at 10% of the maximum radiation power level for the various xenon lines was determined according to the Planck relation. The resultant dependence of the 10%-level temperature in the discharge gap on the wavelength and on time as well as dependence of the duration of a 10%-level radiation pulse on the wavelength indicate that gas-discharge tubes can be used for such an evaluation of photoreceivers at these wavelengths, but a reasonable accuracy will be possible only if the time constant of the photoreceiver is sufficiently long. Figures 4; references 9: 8 Russian, 1 Western.
[7-2415]

A TUBULAR EVAPORATOR WITH RADIATIVE HEATING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 8, Aug 79
pp 61-62 manuscript received 18 Jan 79

KABAKOVA, Z. N.

[Abstract] An evaporator for sputtering has been built which operates with radiative rather than conductive heating. It has a vertical tubular construction, with the heater coil inside a ceramic tube mounted coaxially in a thick stainless steel beaker containing the substance and surrounded by two shields for protection against overheating: a radiation shield made of brass wrapped around the beaker and a thermal shield made of quartz forming a cylindrical outer shell. The temperature of the substance, after first increasing linearly with the heater temperature from room temperature to 880°C within 5-6 min, remains constant at that temperature as the heater temperature rises further to 1300-1600°C. This evaporator was used with ZnS, producing 56 g/min of film of fairly uniform thickness on a substrate lying 340 mm above it. A layer of quarter-wavelength thickness with an optical density $nd = 2.65 \mu\text{m}$ was produced within 15 min. Figures 4; references 3 (Western).
[7-2415]

OPTIMIZATION OF A SPECTROMETER FOR PRECISION TEMPERATURE MEASUREMENTS
USING THE NUCLEAR QUADRUPOLE RESONANCE METHOD

PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, 1979 pp 19-21

SAVATEYEV, A. V. and VOROB'YOV, I. V., candidates of technical sciences

[Abstract] The three primary problems which determine the success of a precision NQR thermometer are as follows: theoretically sound selection and experimental application of the most suitable NQR substances; optimization of the method and signal detection circuit of NQR guaranteeing high-precision measurement of the resonance frequency; establishment of the theoretical dependence $\nu_0(T)$ for the selected NQR substance in a temperature equivalent to within $\pm 10^{-3}$ K. A second problem is considered: the principle of NQR signal detection using an oscillator/detector of the regenerative type. This circuitry must meet requirements imposed on it and be designed through careful analysis of regenerative circuits used in NMR and NQR spectroscopy to define their merits and shortcomings. The Pound-Knight-Watkins (PKW) circuit in its various

modifications is preferred for high-precision spectrometry and NQR thermometry. Robinson's weak oscillation circuit has many advantages and has become more popular in recent years: its reliability is assured by connection of a limiter to the feedback circuit to attenuate noise, thereby improving the signal-to-noise ratio. Here, the PKW circuit is chosen for the oscillator/detector; it employs two FETs which provide high input and output impedance required for maximum Q of the oscillation loop. Potassium chlorate was employed as the NQR substance: this method permits reliable detection of the NQR signals in the temperature range of 70-500 K. Figures 1; tables 1; references 26: 16 Russian, 10 Western.
[416-8617]

USSR

UDC 621.317.799

THE POISK-A, AN INSTRUMENT FOR DETECTION OF THE LOCATION AND ADDRESSING OF CONDUCTORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 4, 1979 pp 286
manuscript received 17 Feb 78

BONDAR', V. A., SAVCHUK, V. L., SKOTNIKOV, A. A.

[Abstract] The "Poisk-A" instrument is used for contactless detection of the location and address of conductors, for example, primary transducers such as resistance strain gages and thermal resistors glued onto structures being tested and covered with nonconducting materials. The operation of the device is based on application of an audio frequency alternating current to the test objects, and measurement of the electromagnetic field by means of a magnetic head provided with the device. The instrument consists of an audio frequency oscillator contained in the main body of the instrument; a needle-type output voltage meter and a multiple-key push button address switch. A pencil-shaped probe with a magnetic head from a cassette tape recorder in its tip is used as the detector. The technical characteristics of the instrument are presented: error in determination of location of conductor dependent on thickness of nonconducting cover H. Where $H = 5 \text{ mm}$, error = $\pm 5 \text{ mm}$; where $H < 1 \text{ mm}$, error $\leq 0.5 \text{ mm}$. A photograph of the device is presented.
[471-6508]

USSR

UDC 534.241

USE OF THE SECOND ASYMPTOTIC APPROXIMATION OF DISTORTIONS OF A PULSE IN
ACOUSTIC DIAGNOSIS OF A LAYER ON A HALF SPACE

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 43 No 5,
Sep/Oct 79 pp 933-939 manuscript received 19 Jan 78

NIGUL, U. K., RAVASOO, A. A., Tallin

[Abstract] A study is made of a one-dimensional wave process in a medium consisting of a layer resting against a half space. The wave process which occurs upon propagation of elastic pulses through the layer is mathematically described. Equations are derived for the echo signal propagating through the layer after acoustic pulses strike the interface between the layer and the half space. Figures 1; references 4: 3 Russian, 1 Western.
[486-6508]

USSR

UDC 624.078+624.046

DEVELOPMENT OF A WORKABLE DEMOUNTABLE CONNECTOR IN A SPHERICAL SHELL MADE
OF A BRITTLE MATERIAL. REPORT 1

Kiev PROBLEMY PROCHNOSTI in Russian No 9(123), Sep 79 pp 63-72 manuscript
received 29 Jan 79

KVITKA, A. L. and D'YACHKOV, I. I., Institute of Strength Problems,
Academy of Sciences UkrSSR, Kiev

[Abstract] The purpose of this research is to develop a reliable and workable demountable connector in sectional spherical glass shells subjected to the action of high normal outside pressure, enabling realization of the high stable mechanical characteristics of this material revealed by compression tests. A theoretical investigation is made of the stress-strain state of a composite spherical shell of glass with a metal insert in the form of an equatorial frame ring subjected to external hydrostatic pressure. Numerical solution of an axisymmetric mixed problem of linear elasticity theory reveals the details of the stressed and deformed state. The finite element method is recommended for calculating demountable connectors for brittle shells. An examination is made of the feasibility of selecting the shape of the metal reinforcement ring by engineering calculations, the principal technological design parameters of the connector are singled out, and values of these parameters are recommended on the basis of analysis of the stressed state. Suggestions are made on reducing stress intensity in the local zone of

the glass component of a composite shell, resulting in a considerable improvement in the magnitude and stability of the load bearing capacity of the shell. The demountable connector disturbs the stressed state of a composite shell much more than does a cemented joint. Design of the demountable connector must include delineation of the zone in the glass component that requires high-quality machining to get a cross section of uniform thickness. In addition, it is necessary to check for flaws in the zone of the glass component that is subjected to stress concentration. Any openings in the shell must be made outside of the zone where stresses are affected by the presence of the demountable connector. Figures 7; references 8 (Russian).
[450-6610]

USSR

UDC 69.32.001.5

FROST-RESISTANT CONCRETES BASED ON FINE-GRAINED SANDS

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 11, 1979 pp 24-26

IVANOV, F. M. and KREKSHIN, V. YE., Moscow, NII ZHB [Scientific Research Institute of Concrete and Reinforced Concrete]; Tyuman', SibNIPigazstroy [Siberian Scientific Research and Project Design Institute of Gas Industry Construction]

[Abstract] Northern West Siberia lacks sands satisfying the requirements of the State Standard for use in concrete. Nevertheless, the strength and frost resistance of the local fine-grained sands were investigated and found satisfactory. The tests were performed on prism-shaped specimens of 6 different concrete compositions prepared from grade-400 Portland cement of Sebyakovskiy Plant and from Surgut Quarry (Tyumenskaya Oblast) sand. Following their curing at $\leq 80-85^{\circ}\text{C}$ for 16 hr and hardening in water for 7 days, the specimens were alternately frozen at -50°C for 6 hr and thawed in water at 18°C for 4 hr. All 6 displayed a high frost resistance; the concretes of grades 350-400 (water-cement ratio 0.3-0.35) withstood 200-400 freezing-thawing cycles, and the concretes of grades 250-300 (water/cement ratio 0.4-0.45), 175-200 cycles. But the specimens with a capillary porosity of $\leq 17\%$ and a hardness of ≥ 50 s proved to be the most suitable. It is thus concluded that fine-grained concrete based on local fine sands (with a higher content of < 0.14 mm fraction) can be used in the construction of buildings and structures in the regions of Siberia and the Far North. Figures 2.
[5-1386]

**CONCERNING CRITERIA OF RELIABILITY OF THE METAL OF 15Kh1M1FL STEEL
TURBINE HOUSING CASTINGS**

Moscow TEPLOENERGETIKA in Russian No 10, Oct 79 pp 20-23

GLADSHTEYN, V. I., SHESHENEV, M. F., AVRUTSKIY, YU. D., candidates of technical sciences, and SHERBAUM, N. L., engineer, All-Union Heat Engineering Institute

[Abstract] The authors studied the structure and mechanical properties of specimens cut from the housings of cylinders and check valves of K-160 and PT-60-130 turbines. The studies involved metallographic analysis and mechanical testing. In addition, the microhardness of structural components of the metal was determined along with the chemical and phase composition of carbide deposits. The housing material was grade 15Kh1M1FL steel. The results of the studies show the influence that 50,000-120,000 hours of operation has on the yield strength, impact strength, permanent strength and cracking resistance of the metal used in turbine components. Recommendations are made on the basis of the results. A value of $26 \cdot 10^7$ Pa is set as the lower limit for reduction of yield strength of parts that are to last 70,000-100,000 hours beyond the rated service life. The norm for impact strength should remain at a level of $3 \cdot 10^5$ Pa·m. When the yield strength and impact strength fall below these norms, the crack resistance of the metal should be tested by the VTI express method for determining additional criteria: critical opening and hot hardness at a working temperature corresponding to the steam temperature at the inlet to the turbine. Figures 3; references 6 (Russian). [477-6610]

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